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ABSTRACT

The knowledge development concept (KDC) described in this report is designed to prepare the public to take full advantage of the National Information Infrastructure. Implementation of KDC will redirect the efforts of the education industry from stressing information technology as tools and skills to the use of information technology for educating individuals in knowledge development. The first four chapters discuss various aspects of the information industry. Chapter 2 describes government information resources, on-line resources, CD-ROMs, Project Gutenberg, the selection of a Chief Information Officer, and information industry highlights. Chapter 3 addresses aspects of the communications industry such as deregulation, common carriers, telephones, satellites, networks, the information superhighway, and other services. The computer industry is the topic of Chapter 4, including the United States' leadership in the industry, the industry's highlights, computer communications overlap, and the entertainment industry. Chapter 5 covers various issues related to the education industry, including information technology; students; education in communications, computing, and information management; software development; and K-12 responsibility. Information technology efforts now underway form a foundation upon which to build the knowledge society described in Chapter 6. Finally, a new Department of Knowledge Development is only one of the several recommendations offered in Chapter 7. (Contains 339 references.) (MAS)

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KNOWLEDGE DEVELOPMENT: Raising Education and Training To A New Level

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KNOWLEDGE DEVELOPMENT:
Raising Education and Training
To A New Level

1. INTRODUCTION

Since The Closing of the American MIND by the late Allan Bloom, many reports have appeared about the education industry. The real time reporting of the Persian Gulf War demonstrated how the military and news services had changed. This indicates how the education industry must change.

The taxpaying public as well as all students need to be educated so that they can benefit from and guide the developing National Information Infrastructure (NII). Contrary to the Luddites' claim that the NII will never materialize, the NII is happening now. Many of us already use the Internet, one of the infrastructure's building blocks. According to Vinton G. Cerf, president of the Internet Society, the Internet was expanding as much as 100 percent per year (Bollag 1994).

The Internet is an international network of thousands of computer networks allowing users to work together as if in neighboring offices although they may be continents apart. The Luddites never expected to see more TVs than telephones in American households. Neither did they expect to see K-12 students carrying their own calculators. Soon, students will be carrying their own computers. It is no longer a case of whether or not the NII will happen, but rather how long it will take. This time frame is dependent upon the public's understanding of the implementation of the NII, an ability only education can provide.

Before American taxpayers can be expected to support the NII they must be educated. Just as we endorse driver education in America, we must educate the computer drivers on the NII. Students need to be educated first so that they will assist in educating their parents and neighbors. We accept the need and accompanying cost of drivers education. The taxpaying public will also accept the cost and time for computer driver education if they understand the reasoning for the need to do so. Without proper education the NII cannot be expected to fulfill its potential.

The following statement was extracted from an NII Executive Summary:

> All Americans have a stake in the construction of an advanced National Information Infrastructure (NII), a seamless web of communications networks, computers, databases, and consumer electronics that will put vast amounts of information at users' fingertips. Development of the NII can help unleash an information revolution that will change forever the way people live, work, and interact with each other (NII 1993).

The May 1994 Report of the Information Infrastructure Task Force Committee on Applications and Technology identifies eleven

federal agencies actively in support of the development of the future NII from among the many other agencies that support instructional activities involving telecommunications technology (NTIS 1994, 62). This number of agencies is an indication of the coordination problem the Executive Branch has in the implementation of the NII; and why public support is so important.

The methods used to educate America during the past half-century require redirection. Instead of acquiring a paperless office, as so often promised a few years ago, the public is attempting to survive under an **information overload**, called the **INFOBOG** by **Rick Tetzeli**. Technology, according to Tetzeli, made the infobog possible which has resulted in a 51 percent increase in the shipments of office paper since 1983, and since 1987, an increase of 365 percent in E-mail addresses, cellular phones, pagers, fax machines, voice mailboxes, and answering machines. Adding to the infobog problem is the absence of many secretaries and executive assistants, the human information filters so valuable to business managers in the past (Tetzeli 1994).

The application of information technology has been carried out by technical experts who speak their own language and have failed to encourage functional area managers and end-users to become equal members of design, development, implementation, operation, and maintenance teams. This problem is made worse by a division between academic and administrative computing in many colleges and universities. Contributing to the problems in application development are the vendors who use many campuses as testing grounds for their development efforts and then resell what they learn to other colleges and universities without allowing the educational industry to benefit from their contributions. A similar situation exists in the private sector where industries are unable to dictate or benefit from their education of vendors at some other company's expense. Functional area users are as beholden to IT professionals and vendors as are their counterparts in academia.

The **knowledge development concept (KDC)** described in this report is designed to prepare the public to take full advantage of the implementing NII. The KDC will encourage students of all ages to take advantage of **life-long learning**. The implementation of the concept will redirect the efforts of the education industry from stressing information technology as tools and skills to their use for educating individuals in knowledge development.

The next four chapters describe the **information society**. Unfortunately, the whole country has not reached the desired level of information technology implementation. However, many of the goals have been reached and most have been accepted. Sincere efforts now underway form a foundation upon which to build the **knowledge society** described in Chapter 6. A new Department of Knowledge Development is one of the recommendations in Chapter 7.

2. THE INFORMATION INDUSTRY

The term **Information Society** describes the environment in which we live today. Four major industries make up the information society: the information industry, the communications industry, the computer industry, and the education industry. A fifth, the entertainment industry, is joining the group.

The magnitude of the information industry is hard to comprehend because of its vastness. As a national and international resource, improvements are causing continuous changes to be made. For example, a reference showing what the information industry includes is the Information Industry Directory (IID), published annually by Gale Research, Inc. The fourteenth edition published in 1994 continues to require two volumes. Volume 1 is a Descriptive Listing requiring over 1500 pages. Volume 2 is a listing of a variety of Indexes filling an additional 800 pages.

Volume 1 of the IID provides a guide to the entire information industry with approximately 5,100 information organizations, systems, products, and services involved in the production and distribution of information. These are arranged in alphabetical order and include worldwide locations in 67 countries, plus references to over 5,200 computer accessible databases. In addition, there is a listing of on-line vendors, consultants, database producers and related associations, research organizations, publishers, optical publishing services, library networks and management systems, information storage software, and information retrieval firms.

Volume 2 of the IID provides 31 indexes to materials appearing in Volume 1, 23 of which are grouped within the **Function/Service Classification** section. For example, about 100 pages are required to index such items as abstracting firms. Other indexes include data retrieval, indexing, and library software systems. These are examples of representative items making up the information industry today. (Novallo 1994).

The information industry includes books, newspapers, magazines, microfilm, video tapes, television, and CD-ROMs (Compact Disc-Read Only Memory). Networks are additional information resources. In 1993, it was estimated that there were 42,000 U.S. book publishers. This total includes some very small publishers as well as those extremely large. The number of total book titles released in 1992 was actually 147,000 (Appelbaum 1993). Books are only one portion of the information industry.

A software package called **InfoMapper**, designed and developed by **Forest Woody Horton, Jr.**, supports the management of information resources, both internal and external, for any type of organization. The software is available from **Information Management Press**, Washington, DC (IMP Newsletter 1992).

GOVERNMENT INFORMATION RESOURCES

The largest sources of informational data are government agencies. International, foreign, federal, state, and local agencies make up these numerous governmental resources. The volume alone indicates the need for learning how to identify and

access these extensive resources. Numerous policy initiatives are currently being considered to enhance the availability of information in the hands of the federal government.

An example of the data available is the **National Technical Information Service (NTIS)**, a self-supporting agency of the U.S. Department of Commerce. This agency operates a national clearinghouse to collect and distribute scientific, technical, and engineering information, both foreign and domestic. An increasing amount of the material is in digital form. NTIS is sustained by its sales revenue. This includes salaries, marketing, postage, and all other operating costs paid from this revenue (NTIS 1993).

NTIS operates an integrated electronic access service called **FedWorld** as an on-line information resource. This service provides both dial-up and Internet access and provides a gateway through the system to over 130 other publicly available government information systems, including over forty agencies that operate bulletin boards, and identifies 175 publicly available **federal databases** (NTIS 1994, 88).

The United States Government Manual is the official handbook of the federal government, published as a special edition of the Federal Register. This manual, with over 900 pages, provides comprehensive information on the agencies of the legislative, judicial, and executive branches. Information is included on quasi-official agencies; international organizations in which the U.S. participates; and boards, commissions, including committees.

A typical agency description in the manual includes a summary statement of the agency's purpose and role in the federal government. The principal officials are listed with a brief history of the agency, including its legislative or executive authority, a description of its programs and activities, and a "Sources of Information" section. This section is of special importance to this discussion as a major information resource. The section includes information on consumer activities, contracts and grants, employment, publications, and many other areas of public interest.

The Sources of Information section for the Department of State includes instructions for requesting documents under the provisions of the **Freedom of Information Act** (5 U.S.C. 552). The persons who can request information under the **Privacy Act** (5 U.S.C. 552a) are described. The section gives information for obtaining a videotape on the safety of international travel and on the issuance of U.S. passports. Similar helpful instructions are included for other agencies.

The Federal Register is published every federal working day to provide a uniform system for publishing Presidential documents and others required to be published by statute. Companion documents are the Code of Federal Regulations, the Weekly Compilation of Presidential Documents, and the Public Papers of the Presidents. For more information see the "Sources of Information" section for the Government Printing Office (U.S. Government Manual 1993/94). An example is a listing of the GPO

Bookstores across the country. The Federal Register is also available on-line as **FREND (Federal Register Electronic News Directory)**.

The Congressional Record is issued when Congress is in session to publish the proceedings. This publication was the first record of debate officially reported, printed, and published directly by the federal government. A Daily Digest, summarizing the proceedings of that day in each House, and before each of their committees and subcommittees, is printed on the back of the Congressional Record. The Digest also presents the legislative program for each day, and at the end of the week, the program for the following week (U.S. Government Manual 1993/94).

Retrieval of Data

During 1990, the Department of Defense's Advanced Research Projects Agency initiated a four-year, $8 million **TIPSTER** Text Program. The objective of this program is to design and develop innovative approaches that lead to or enable revolutionary advances in the state of the art of multilingual text retrieval (CBD 1990). Within this program, one of the projects was a two-year award for $689,000 for two professors at Syracuse University School of Information Studies. According to a report in Information Today, this effort was for the construction of a broad-based document retrieval system to be hardware, language, and domain independent. In addition, it would retrieve all kinds of documents from many sources (Information Today 1991).

The TIPSTER project entered Phase II during April 1994. Phase I, referred to above, was directed toward technology development. The results justified a continuation with the objective toward technology deployment. This includes continuation of the research and development of the technology, the deployment of actual model systems, and the creation of a common architecture that will provide rapid porting of the data in many environments. The TIPSTER project is a key effort necessary for the NII to meet its expectations. The project has the support of the National Performance Review group, Vice President Gore's 'Reinvention Team' of the federal government (Doddington 1994).

The increasing use of multimedia makes the retrieval of full-motion video and sound, in color, a much greater problem than text retrieval alone. A step in the right direction is the result of efforts by a dyslexic programmer, **Jim Dowe**, now marketed as **Excalibur**, by a San Diego-based firm by the same name. Dowe used his knowledge of nature's pattern-recognition system in **DNA** teaching his computer to do the indexing on-the-fly (Rothschild 1994).

Under **Item V, Principles and Goals for Government Action** of **The National Information Infrastructure: Agenda For Action**, Point 9 specifies that the federal government is to take every step to improve the process of information collection, manipulation, and dissemination. To help the public find government information "an inter-agency project has been formed to develop a virtual card catalogue that will indicate the availability of government

information in whatever form it takes." Legislation has also been enacted to improve electronic dissemination of government documents (NII 1993).

On January 3, 1994, the **National Archives and Records Administration** opened its sleek new building in suburban Maryland to researchers. However, it will be another two years before all the documents will be in place. The installation is known as **Archives II**, unofficially. An initial shortage of staff has generated some comment concerning the use of the new facility (Coughlin 1994). It will take additional time to properly evaluate the services and to learn how well the new surroundings interface with the latest in information technology. The old and well-known Archives facility in the District of Columbia will continue to operate.

Census Data

Gathering U.S. Census Data illustrates how the census has grown from a survey to determine political representation to the American corporations' most important planning and marketing tool. The century between the 1890 U.S. Census and the 1990 U.S. Census demonstrates the increasing importance of gathering data for providing information. A major difference in the 1990 data gathering was the ability to cross-reference the basic demographic information with computerized maps of every city block in the nation. This method permits the creation of a staggeringly detailed portrait of consumers. These maps, called **TIGER** (Topographically Integrated Geographic Encoding and Referencing), permit marketers to refine their efforts to gather detailed data. Most of the 1980 census was broken down by census tract and zip-code areas. These provided larger geographic areas and permitted data showing greater fluctuations of income and lifestyles (Farhi 1990). Unfortunately, the Census data omits individual SSNs; however, the data are available on CD-ROMs for the first time.

Patent and Trademark Data

Most states have **Patent and Trademark Depository Libraries** that give independent inventors a place to go and do patent research on their own. A major factor in the geographical location of the facility in the state is the number of recognized inventors within a specific area. This was true in the location of the first Kansas patent depository at Wichita State University's **Ablah Library**. The many inventors in the Wichita area were a major factor in deciding to locate at WSU as opposed to other universities. Wichita, Kansas is known as the **Air Capitol** because of the concentration of small airplane companies and suppliers. Before the establishment of the patent depository, inventors who wanted detailed patent information had to use patent depositories in Kansas City or at Oklahoma State University (Weber 1991). Like the census data, the patent and trademark data are also available on CD-ROMs.

Library Resources

The **Library of Congress** opened in 1800. In 1833, three decades later, the first tax-supported town library in the U.S.

opened in Peterborough, NH. In 1854, the Boston Public Library opened as a free service and the tax-supported library became part of American life. Melvil Dewey published the first edition of his Decimal Classification in 1876, and 11 years later organized and directed the first library school at Columbia University (Gates 1983). The number of volumes in library holdings is still used as a primary measurement tool for ranking libraries based on data from the Association of Research Libraries (Almanac 1993). A portion of a footnote comment on the chart listing the Holdings of Research Libraries is appropriate as it points out that the index does not measure a library's services, the quality of its collections, or its success in meeting the needs of users (Gragasin and Thompson 1994). Evaluations based on the number of volumes should be replaced with a measurement of how well information is made available to users.

Within the library portion of the information industry there are two contradictory roles described by Herbert S. White: self-service and information intermediary. Many librarians see themselves simply as educators to prepare students for self-service. The other role, that of information intermediary, is most commonly performed by special librarians in the corporate sector. In the special library environment, the user is not to perform self-service, but rather be provided with information required for whatever purpose the user desires (White 1992).

There are many different specialists among library professionals. For example, special librarians hold their own annual meeting. They are a small group when compared with the membership of the American Library Association (ALA). The 110th Annual ALA meeting returned to Atlanta in 1991 after a ninety-one year absence. The ALA program ran 312 pages in fine print, with more than 7,000 exhibitors, 10,000 registrants, and 12,000 visitors (Nelson 1991). In spite of limited budgets, over 8,000 attended the 112th meeting of the ALA when it was held in New Orleans during June 1993 (Webb 1993). These numbers are not so staggering when it is realized that there are approximately a hundred thousand libraries in America.

According to those attending national meetings for professional librarians and others interested in information storage and retrieval, the most notable change taking place is that individuals participating are no longer made up of only librarians. Attendees from the business world include attorneys, CPAs, engineers, doctors, and faculty from various disciplines.

Library automation is beyond being a form of status symbol because it discontinues the need for the old card catalogues. Unfortunately, the total discard of the cards is hard to accomplish because of cost of manpower and shortage of funds. A large portion of the funding problem is due to the increasing costs of subscriptions to professional journals. Fortunately, the introduction of electronic journals is helping eliminate a portion of this problem. Library automation extends beyond card catalogues and into nearly all functions performed such as

acquisition, costing, circulation, serials control, and provision for access to bibliographic records.

During the fall of 1991, the New York Public Library announced plans to open a new library described as a "**library without walls.**" The new library will be the **Science, Industry, and Business Library (SIBL)**. The SIBL will use information technologies to provide new kinds of targeted services to small businesses, entrepreneurs, corporations, scientists, secondary and college students, and research scholars. When the SIBL opens in 1995, it will be the largest library of its kind in the world. As a library without walls, the SIBL will have a national and international reach, making its electronic data bases available with 24-hour dial-in access, telephone reference, and access to the **INTERNET** (Information Today 1992).

Similar to the library without walls, the **virtual library** concept is a system by which a user may connect transparently to remote libraries and data bases. This is possible by using the local library's on-line catalog system and a local area network as a gateway to external networks. An increasing amount of the information a user requires, such as bibliographic, journal citation, or full text, is stored somewhere and available for retrieval in digitized format (Mitchell and Saunders 1991).

According to **John Garrett, digital libraries** will be the grand challenges of the future, requiring structures for building information and knowledge, not just data. Of course, he points out that his digital libraries do not reside in buildings. With correct design, their information arrives as needed at the user's screen (Garrett 1993).

Brian Hawkins of Brown University recently pointed out how **Andrew Carnegie's** philanthropic contributions to our nation's libraries fundamentally changed the fabric of the country. Dr. Hawkins' concept for the **National Electronic Library** model to be an independent nonprofit organization is worthy of serious consideration for making a national contribution. Professor Hawkins believes that the library of the future will be about access and knowledge management, not about ownership, (Hawkins 1994). His view seems consistent with the knowledge development concept being developed in this report.

ON-LINE RESOURCES

Less than a decade ago the literature contained numerous articles about the advantages of on-line searching capabilities. A 1985 Fortune magazine article was entitled "**Life Will Be Different When We're All On-Line.**" The article stated that examples of those trying to change the world by the use of on-line databases included Lockheed, Mead, Dow Jones, Reader's Digest, H&R Block, and the SEC (Seligman 1985). Since that time, the growth of on-line databases has exceeded all expectations. For example, the first edition of what was then called Computer Readable Databases listed only 301. The eighth edition in 1992 listed about 6,800. The growth quadrupled between the third and fourth editions, and nearly doubled between the next two editions (Marcaccio 1992). The publication is now the Gale Directory of

Databases, from Gale Research, Inc., with the 1994 edition containing over 8,700 references (Miller 1994).

There are a number of organizations that provide data and information as a service and for a price. College and university libraries most often have access to some of these services. Due to the cost, restrictions are to be anticipated. Again, the volume of information available is staggering. The following examples are only representative of the many organizations that provide similar services.

News Service Example: NewsNet

This service provides full text of over 600 newspapers, magazines, and business newsletters on-line. For example, the service can retrieve an article that ran 10 minutes ago. The **NewsFlash** service will sift the news for the subscriber by scanning over 15,000 articles each day, 24 hours a day, to compile a concise, personal news briefing.

Financial Data Example: Dow Jones News/Retrieval

This service provides business news and information, including the full text of The Wall Street Journal and Barron's, plus the breaking news from the proprietary Dow Jones newswires. The full text of more than 30 major U.S. newspapers, 20 of the most prominent business publications, such as Forbes, Business Week, Fortune, and the Economist, are included. There are more than 1,000 other local, national, and international publications and newspapers, from the Alaska Business Monthly to the Miami Review. There are also many databases available.

Search Service Example: Dialog Information Services, Inc. is one of the largest on-line full-text sources of information. These services could be listed as a news and financial service as well as a search service. However, the search option makes this and other search services distinctive. Dialog's search capability allows the user to search groups of databases as well as a single specific database. The user can access over 400 databases from a broad scope of disciplines. A special service is provided for students to access information on virtually any subject under a **Classroom Instruction Program.**

Information Network of Kansas (INK)

The Information Network of Kansas is unique by being a private/public adventure organized by the State of Kansas. INK is governed by a 10-member board appointed by the governor. According to the INK's marketing information:

> INK has leveled the playing field for Kansas Attorneys by allowing **real-time** electronic access to a host of services such as: Complete Legislative information including Full Text of all current bills making their way through the legislature and Enrolled Bills prior to their publication in the Session Laws, Kansas statutes Annotated, Session Laws, Kansas Administrative Regulations, Kansas District Court access to Sedgwick, Shawnee, Wyandotte and Johnson Courts, UCC Searches and Filings, Kansas Corporation Records, Drivers License Records, Vehicle Title Registration and Lien

Records, the Federal Register, Kansas Bar Association Network and much, much more. In coming weeks, INK will be adding Full-Text of Legislative Committee Minutes with Testimony going back to the 1971 legislative session, a Kansas Public Policy Bulletin Board and other services" (Staab 1994).

Kansas is only one of several states moving ahead with their own information highways. Others are Alabama, Arizona, Iowa, Louisiana, North Carolina, South Dakota, Texas, Utah, Vermont, and Virginia (EDUPAGE 1994d).

Barbara Quint, of Information Today, recently asked the key question, applicable to all search services: "Will the search services last?" (Quint 1994). Perhaps this question had a bearing on the **Mead Corporation's** decision to sell its **Lexis/Nexis** electronic data services to **Reed Elsevier PLC**, the Anglo-Dutch publishing giant (Narisetti and Steinmetz 1994).

CD-ROMs (Compact Disc-Read Only Memory)

The use of CD-ROMs by many different organizations for the storage of databases created what is known as **portable databases**. By providing a new CD-ROM either quarterly, monthly, or sooner, the databases are updated and the data kept current. This makes portable databases very competitive with on-line databases. The first issue of the Directory of Portable Databases in 1990 listed 600. This number made the ratio of on-line databases to portable databases about 7 to 1. By 1991, the number of portable databases had increased to more than 1,500 with a ratio of about 3 to 1 (Cuadra 1991). By 1992, an international directory of compact discs listed 3,000 from 2,600 publishers (Briefly Noted 1992).

CD-ROMs are becoming one of the most attractive and inexpensive methods to store and deliver vast amounts of data. Initially, CD-ROMs were useful only for the storage of reference data where frequent updates are not required. Now that frequent updates of the discs are more feasible, numerous computer-based databases are being replaced. The use of discs will reduce the number of reference books, computer storage requirements, manuals, and papers. In addition to the reduction in space, communication costs are reduced or eliminated.

Quality control has not been well carried out in the production of CD-ROMs according to numerous reports in the press. For a well balanced account of CD-ROM products as of the end of 1993, see Peter Jacso's article (Jacso 1994a).

There are numerous unexpected areas profiting from the use of CD-ROMs for interactive information and entertainment. A major asset is that personal computer vendors are making CD-ROM drives available at reasonable prices. Many companies market CD players that make use of TVs as display screens. Although the **CD-I (Compact Disc-Interactive)** concept marketed by Phillips Electronics as a CD-for-TV has not been widely accepted, it is an important resource (Schwartz 1993). The major competitor is the **Multimedia PC (MPC)** developed by a consortium of hardware vendors using IBM-compatible personal computers. Three popular programs

are Compton's Interactive Encyclopedia, Grolier Multimedia Encyclopedia, and Microcoft Encarta.

At COMDEX FALL '93, Compton's president announced that a patent was held on the multimedia information storage and retrieval methods developed for Compton's Encyclopedia. According to Jacso's definition, he describes multimedia as the integration or some combination of audio, video, images, and text (Jacso 1994b). Since that time, several press reports have confirmed that the U.S. Patent and Trademark Office had overturned the Compton patent. At COMDEX FALL '94, Microsoft Corporation Chairman William Gates, a keynote speaker, updated his concept of information at your fingertips, (Clark 1994).

PROJECT GUTENBERG

Michael S. Hart, when a student at the University of Illinois in 1971, entered a copy of the Declaration of Independence on a university computer system and began what is known today as Project Gutenberg. The objective of the project is to have 10,000 books recorded in electronic form and available to all Internet users by the year 2001 (Graham 1991b). The project is not without opposition. Even though the contents of the books in the project are intended to be available in the public domain, many librarians consider the material to be trash because important reference information such as edition, typeface, version, etc. is omitted. Hart's concept is to reach the vast majority of the public (Wilson 1992a,b). A Project Gutenberg CD-ROM is now available from Walnut Creek CDROM in ISO-9660 format with all files using plain ASCII. Updates are automatically available by subscribing (Walnut Creek 1994). Hart's efforts are an example of what one individual can do to make a difference.

CHIEF INFORMATION OFFICER (CIO)

Credit for suggesting the chief information officer (CIO) title is given to William R. Synnott (Synnott and Gruber 1981). His critics charged that the CIO idea was a ploy to increase the stature and control of the MIS boss, since it came from a data processing veteran. In a later book, Synnott describes how control will slowly be transferred away from the technocrats and into the hands of business managers. Unfortunately for Mr. Synnott, this happened to him after he acted as CIO at the Bank of Boston for many years without the title, then took early retirement. Prior to his departure, he had to report to a banker who was given the title of CIO (Carlyle 1987).

Corporate America is reluctant to accept the designation of an individual as CIO to be responsible for the management of information. A review of the list of attendees at a Society for Information Management (SIM) conference showed only four out of over 400 attending were using the CIO title. A 1991 survey mailed to all SIM International members disclosed that only 10 percent of the 580 responses from 620 members gave their position as CIO (SIM 1991). According to the 1993 Business Week profile of the typical boss in their group of 1,000 organizations, not a single CEO included CIO or information management on his or her career path to the top (Bhargava and Jespersen 1993). Only 13 of the top

Computerworld 1994 Premier 100 company executives were listed as CIOs (Premier 100 1994). The position title information resource manager is used more often in the federal government than CIO.

Corporate America is not satisfied with the results of spending billions of dollars on information technology. Their dissatisfaction is shown in the turnover of individuals in the position of CIO who, no doubt, in many instances are the fall guys for the CEOs who did not have sufficient background to make the proper decisions. As stated previously, it is the CEO and the functional area managers who are truly responsible for their computer applications.

The responsibility for the leadership in managing information must rest with the president and CEO, not the CIO, not the director of IRM, not the vice president for information technology. These are technical staff positions and not management positions other than for the management of the personnel and operation of their immediate offices. From the CEO, the responsibilities for information management flows downward or outward, depending on the type of organizational structure in place, to the managers of functional areas. This management should include the computer and networking systems and applications that support their functions. When there are multiple functional areas involved or supported by the same application, then the primary user should be held responsible.

Managers have responsibility for their budgets, their personnel or human relations management, and day-to-day operation of their functional areas including the management of the information they use to support their endeavors. This should include the management and operation of the computer supported systems and applications for their areas. Strategic planning for the management of the IT functions of an organization should be included within the strategic plans for the organization as a whole. For many years it was recommended that the IT strategic plans be separate; then the IT strategic plans were to be adopted to carry out the organizational strategic plans.

INFORMATION INDUSTRY HIGHLIGHTS

The library portion of the information industry is beginning to redirect its objective away from buildings and the number of books in inventory toward distributed facilities making access and service the primary concerns as digital libraries.

The information industry is no longer concerned with only text material. A decade ago, the use of **micrographics**, computer output in microfilm that could be cut into microfiche, were examples of technology. Now, multimedia has compounded the problem by adding the need for integration of audio, video, and images in full color in addition to text. Information is needed by individuals at their own personal computers from resources available. After watching bombing missions and other expolits brought into our living rooms during the war in the Persian Gulf, our demands on commmunications technology increased.

3. COMMUNICATIONS INDUSTRY

The invention of the telephone in 1876, the wireless telegraph in 1893, and **Claude Shannon's** information theory in 1948 provided the base for the communications industry today. Shannon developed a quantitative means of describing communications systems by treating bits of data as physical quantities. In application, this theory showed that messages can be retrieved from badly garbled versions of themselves through probabilities. If the probability of various kinds of garbling is known, an estimate can be made of the original content of the garbled message (Shannon and Weaver 1949). This theory proved to be a major development in communications.

The communications industry has grown into a very massive and complex effort, now on a global scale. The developing **National Information Infrastructure** makes it urgent for the public to learn about communications. This urgency is prompted by the fact that NII makes greater use of communications than ever previously attempted. Without a program to educate students of all ages, the public will not be able to take advantage of the resources available.

DEREGULATION

The date 8 January 1982 is important for both the communications and computer industries. A thirteen-year-old antitrust suit against **IBM** was dropped by the Department of Justice, termed **without merit**. The seven-year antitrust suit against **AT&T** was dismissed in return for a modification of the 1956 Consent Decree. This decree confined AT&T to regulated businesses only. The 1982 modification eliminated these restrictions, but introduced additional specifications that have undergone continuous review. In summary, these actions permitted AT&T to compete in the computer industry and IBM to compete in the communications industry. Since 1982, both organizations have encountered many problems competing in these areas. AT&T's purchase of NCR is a good example of its effort to become a major player in the computer industry. AT&T changed the meaning of NCR, which once meant National Cash Register, to AT&T's **Networked Computing Resource** (Verity and Coy 1992). In January 1994, according to the Associated Press, the **NCR Corporation** name was changed to **AT&T Global Information Solutions**. This meant the loss of a famous name as it was the late **Thomas J. Watson, Sr.** who gave NCR national recognition. Watson later left NCR when selected to head C-T-R, which he renamed **IBM** in 1924.

COMMON CARRIERS

Companies that provide voice and data transmission services for the public are **common carriers**. Examples of these are telephone companies, telegraph companies, and satellite companies. In foreign countries there are competing organizations such as Post Telephone and Telegraph Administration (PTT) organizations; an example is the Bundespost in Germany, a government entity. These and other common carriers are all competing for their share of the communications market. The

advertisements by AT&T, MCI, Sprint, and LDDS in newspapers and on TV indicate the level of competition. In addition, there are approximately 1,300 independent U.S. telephone companies.

TELEPHONES

The telephone portion of the communications industry now makes it possible to dial, or use voice-activated dialing, to reach a person or an organization almost any place in the world. AT&T has an international language translation service over voice lines from any one language into one of the 140 languages available (AT&T 1993). This eliminates much of the former language barrier that the Esperanto language never accomplished. On the other hand, musical scores make up the most common international language in existence today. Musicians may not be able to carry on a conversation, but they can read almost all music, regardless of its country of origin. An orchestra can be made up of musicians of many different nationalities, all playing the same music, but unable to communicate due to different languages (Thompson 1991).

Unfortunately, over half the country's business calls go unanswered, and the caller ends up playing what is known as **telephone tag**. The use of computers for **voice mail** is reducing the telephone tag problem; however, being unable to speak to a human continues to be a major irritant.

The **Easyreach 700 Service** announced by AT&T in May, 1994, is to allow customers to be reached in any of 127 countries. The service is $10 to acquire a number, then $7 a month, plus the cost of the calls made (EDUPAGE 1994a). It has also been reported that CD-ROMs are published with a nationwide telephone directory and updated frequently.

SATELLITES

In 1958, the **National Aeronautics and Space Administration (NASA)** launched the first U.S. communications satellite. That same year, the **Semi-Automatic Ground Environment (SAGE)** radar early warning system was introduced and continues as **NORAD** (North American Aerospace Defense Command) in Colorado. Satellites operate at a fixed location about 22,300 miles above the earth. Although there are some transmission delays in their use and some problems of security, their popularity is increasing. The use of satellites speeds up the transmission and accuracy of data such as keeping track of a trucking company's vehicles as they move from coast to coast. Another common use is for satellite traffic to absorb some of the volume of data moved over trans-Atlantic and trans-Pacific cables. These cables across oceans have been in place and upgraded for over a century. AT&T has installed enough undersea cable to circle the earth four times at the equator.

A low earth orbit (LEO) satellite system, at an altitude of 435 miles, is recommended for the 840 satellite **Teledesic** by **Craig McCaw** and **Bill Gates**. Teledesic offers the first true global internet to serve personal computers. The main advantage of the LEOs over those satellites dominated by **GM Hughes** in the so-called **Clarke belt** at 22,300 miles is their multimedia transmission capability. This advantage is in addition to the

avoidance of the half-second delay in the Clarke orbit signals and in the size of the antenna dishes. Other LEO projects are projected to be in place by 1998. These include **Motorola's Iridium** and **Loral-Qualcomm's Globalstar**, but available for only simple E-mail, faxes, and paging. **George Gilder** believes that since LEOs are a major American innovation, the U.S. government should take the lead in making changes in regulations to accommodate them (Gilder 1994).

NETWORKS

By leasing long-distance telephone lines from AT&T, companies establish **private networks**. An example is an airline reservation system. Other examples are the two major AT&T competitors, MCI and US Sprint. Both leased long-distance lines from AT&T as they built their own transmission facilities. Some organizations, such as the railroads, can operate private networks with railway telecommunications equipment.

Local Area Networks (LANs)

LANs link personal and other computers by cables so users can exchange information, share peripherals such as printers, and use the same large data storage devices called **file servers**. A campus network is an example LAN. The campus LAN also may be made up of numerous smaller interconnected LANs. The use of a LAN is typical in **distributed computing** applications where each user needs to be provided with a fully functional computer. This concept differs from **multiuser** systems, where users have dumb terminals without their own workstations having processing capabilities. These multiuser systems are well suited for dedicated applications where all users are working with the same software in support of the same function. These concepts also differ from **client/server** computing, discussed later.

Wide Area Networks (WANs)

WANs use high-speed, long-distance communications connections or satellites beyond those distances used by LANs. These WANs are described as **backbone** networks that support numerous LANs. These LANs tie together incompatible and/or distant computers. A typical LAN supports dozens or hundreds of individual desktop computers within one building or on a campus. The industry is now perfecting **hubs**, often called smart or intelligent hubs, that can link different networks and provide other management services. These services enable a wide-area network (WAN) manager to diagnose and configure all the networks involved from one management location. This includes the ability to shift loads from busy segments to others not so busy, pinpoint trouble spots, and help analyze traffic patterns (Churbuck 1991).

It has been estimated that businesses around the world will spend over $3 billion during 1994 on intelligent hubs. Additional funds will be spent on other communications equipment and software such as **Novell's NetWare** and **Lotus Notes**, plus the code they write themselves. Investment in networks is impossible to measure, but without question, it is huge (Stewart 1994b). Networks are changing the way business is conducted and the way students use computers on campuses.

INFORMATION SUPERHIGHWAY

INTERNET and NREN

The concept of **packet switching** was developed under the authority of the **Advanced Research Projects Agency (ARPA)** of the Department of Defense and used in a network called **ARPANET**. The ARPANET became the first national computer network allowing a user to run programs on computers in distant centers. **NSFNET** replaced ARPANET becoming the backbone network for the upgraded **Internet**, referenced previously as an international web of networks. The Internet grew out of an ARPA research project on internetworking in the early 1970s. Internet is not a single network, but the integration or inter-connection of regional networks that operate as a living entity. This allows several million users around the globe. By operating at fantastic speeds, all data movement takes place in real-time (Cerf 1991).

Packet switching is a method of dividing messages for transmission into packets, usually all the same size, and routing the packets to their destinations over the best routes available. This provides users with automatic backup for transmission. These packet switching lines are called **VANs** for **value added networks**. The value added was the packet switching capability. Commercial charges are based on the size of the message sent, rather than the distance the message travelled. For years, universities took pride in being an ARPANET site. Now, they should all have access to the Internet. Using the Internet is expected to be an introductory step toward using the **NREN**, a projected information superhighway.

Section 102 of the High Performance Computing act of 1991 defines **NREN** as the **National Research and Education Network.** By 1996, this network is expected to be capable of transmitting data at one gigabit (one billion bits) per second or greater. The NREN is envisioned as the ultimate **information superhighway** linking millions of schools, libraries, universities, and government researchers around the world. The **National Science Foundation (NSF)** has primary responsibility for connecting all colleges, universities, and libraries to the NREN. The Internet uses **TCP/IP, Transmission Control Protocol and Internet Protocol.** TCP/IP is a non-proprietary protocol, developed by the U.S. Government through the leadership of **Vinton Cerf** and **Robert Kahn.** The magic of the TCP/IP is that it is the one protocol used by all the computers in the world that use the Internet. The NREN will expand and enhance the current connectivity of the Internet, deploying advanced technologies and services as they mature (Lunin 1992).

An indication of the global impact of the Internet is shown by the results gathered in late-July 1994. There are 3.2 million reachable machines from more than 80 countries according to **Mark Lottor** of Network Wizards. His **Internet Domain Survey** identified 46,000 domains (Internet Society 1994).

The Internet Society conference, INET'93, in San Francisco was made up of nearly 900 people from 91 countries. INET'94, held during June 1994, in Prague, Czech Republic, attracted 1,100

people from more than 100 countries. A Singapore official let it be known that his country's intention is to become the first **intelligent island**, with every home and office hooked up. Unfortunately, there is only minimal connectivity to China, and the shortage of funding prevents the desired usage by Russia. The opposition to commercialization and over-regulation of the Internet were common points of discussion during the conference (Bollag 1994).

In 1992 there were those who feared the NREN because they believed that vast resources--tax money--would be allocated to the creation of a giant network for use by a very small group of scholars, experts, and entrepreneurs. It was pointed out that even within a university faculty, only a small percentage are actually engaged in meaningful research (Berry 1992).

In the U.S., there is a misconception that the Internet system is free. The Internet has never been free. The funding comes from a variety of sources. The misconception, to some extent, originated with an overextension of the interstate highway analogy that Vice President Gore often uses. His father, as a senator from Tennessee during the 1950s, often is given credit for the interstate highway concept. Former President Eisenhower also shares credit for the interstate highway system. The federal government's investment in support of the Internet system may be as small as 10 percent; however, it is a critical portion (Breeden and Bouman 1993). The press now [summer 1994] carries the threat that, **free rides on the information superhighway could be drawing to an end**, as the National Science Foundation begins moving electronic traffic off the federally-subsidized NSFNet onto privately-run networks (Eagle 1994).

The Internet **Gopher** protocol, developed at the **University of Minnesota**, was designed for distributed document search and retrieval. The **World Wide Web (WWW)**, is more powerful than Gopher in that the Web can understand the numerous different information-retrieval protocols used on the Internet of which Gopher is one example. In comparison, the Web can exploit **hypertext**, a computer interface to text which allows cross-references to be followed. **Hypermedia** is an extension which includes graphics and audio. A popular tool for **browsing** searchable archives of multimedia documents on the Web is the use of **Mosaic**, available free from the **National Center for Supercomputing Applications (NCSA)** at the **University of Illinois** (Torkington 1993). Two other Internet protocols are **File Transfer Protocol (FTP)** for copying files between computers and **anonymous FTP**, a variant of FTP where a set of files is made available for public access. For example, **Archie** is a database of files available via anonymous FTP.

The Internet is open to commercial companies as well as to academic institutions. A large corporation pays several thousand dollars a year for its employees to use the Internet at a cost of approximately $3 per employee. An individual without academic or corporate connections may spend between $10 and $25 a month for a commercial Internet sponsor. Academic connection on the Internet

costs colleges and universities between $10,000 and $60,000 a year. There remain many problems to be solved before the funding and operational policies are finalized for the Internet. For example, commercial companies believe that the Internet provides room for a vast amount of advertising, much to the objection of many other users (Stecklow 1993). The **Canter and Siegel green card** case of advertising to offer help for aliens to obtain green cards is the most glaring example. This case is just one of many indications of the need for someone to develop policies before severe damage is done to the leading resource, the Internet (Elmer-Dewitt 1994b).

In view of the increasing number of commercial users, a **Commercial Internet Exchange (CIX)** was created as an association of regional and national networks. This organization agreed to route commercial traffic directly to each other, without going over the NSFnet backbone and violating its **Acceptable Use Policy (AUP)**. There were thirty-six members in the CIX group, according to the latest information (Ubois 1994). The group will be able to speak for its members in their support or opposition to policy questions, as well as provide network support.

BITNET

Because of the additional features of the Internet, such as the ability to retrieve documents from remote computers and browse through distant library catalogs, many schools have dropped their **BITNET** connections. BITNET (**Because Its Time Network**) originated at the City University of New York in 1981 and has nearly 600 U.S. members and more than 700 members overseas. **Kenneth King**, the former president of EDUCOM, became the executive director of the **Corporation for Research and Educational Networking (CREN)** in 1993. CREN manages BITNET and is beginning new projects and scrambling to add more capabilities to hold its members (Wilson 1993). The most recent development is the **BITNET III** project, an effort to build a global dial-up networking infrastructure available through a local telephone call. Kenneth King believes that BITNET III will be a major step on the road toward creating a virtual university (King 1994).

Congressional Hearing On-Line

"The Role of Government in Cyberspace" was the topic of the first Congressional Hearing on-line ever planned to be held over a computer network, the Internet. The Subcommittee on Telecommunications and Finance of the U.S. House of Representatives was to be the sponsor for a July 1993 hearing (Internet Society 1993). However, the hearing was postponed indefinitely, but this effort is an indication of the direction of things to come. During 1993, Congressional offices and the White House began acquiring and using E-mail capability (Mossberg 1993).

Standards

By 1993 corporate America complained that the **networking standards** that would enable truly open systems were still lacking. These organizations were relying on proprietary solutions to solve their interoperability problems. This has

resulted in a number of vendors offering cross-platform development tools (I/S Analyzer 1993). The subject of **standards** is one of those important problem areas identified by the Information Infrastructure Task Force Committee on Applications and Technology (NTIS 1994,90).

Copyright

Another problem in addition to standards is the need to be able to implement **copyright** protection throughout the Internet. The author does not have access to the inner workings of the **Electronic Copyright Management System (ECMS)**, an experimental effort reported by the NII Task Force Committee to be sponsored by ARPA, the Library of Congress, and CNRI (NTIS 1994, 88). However, as a possible solution, it is hoped that those working on the copyright problem are profiting from the experience gained by McGraw-Hill's PRIMIS group. According to **Dudley Land's** description, his firm can keep track of an author's work and identify copyright material as small as two pages (Land 1994).

The PRIMIS experience, when coupled with the track record of the **Copyright Clearance Center** in copyrighted work that is copied, and the control by **Bowker ISBN** of all ISBN numbers issued, become important resources in solving the copyright problem. A related problem is the copyright of data on CD-ROMs. An additional resource is the **Serials Identification Contribution Index (SICI)**, used as the name indicates (Dean 1994).

OTHER SERVICES

On-line Services

Previous reference to on-line resources could be integrated with this discussion. These services vary in charges and are distinctive in the amount of advertising and encouragement the public receives to participate. One of the early pioneers was **The Source**, purchased by a competitor, **CompuServe**, in 1989. (CompuServe's owner, **H&R Block** made the purchase.) CompuServe has a major competitor in **Prodigy**, owned by **IBM** and **Sears**. Both claim between one and a half to two million customers each. The third member of the leading on-line providers is **America Online**, a Virginia-based firm. **MCI** will begin commercial on-line service with its **InternetMCI** starting in January 1995. **Microcoft Corporation** plans to enter the arena with an Internet interface called **Marvel** later in 1995 (Sandberg 1994). A commercial Internet link, **Internet Resources Corporation**, is opening in Wichita, KS (Schrodt 1994).

Bulletin boards are a form of telecommunications utility where individuals communicate and share software. Bulletin boards number in the thousands with new boards being added, and others replacing those that drop out. Some are free, some require an annual or hourly charge, and some users are afraid of a virus.

Fiber Optics

Alexander Graham Bell did not see his invention of the telephone as his greatest achievement. He felt that the distinction should go to an invention made two years later in 1880: the **photophone**. This device made it possible to send and receive voice conversations via light. Scientists say that Bell's

work anticipated today's fiber-optic networks that carry vast amounts of voice and data traffic (Keller 1992).

Wireless Communications

The now popular **MCI Communications Company**, as MCI (Microwave Communications, Incorporated) in the early 1960s, initiated a **microwave service** between St. Louis and Chicago. In spite of AT&T's objections, the FCC granted approval. This opened heavy competition for the transmission of voice and data and led to lower rates for the services offered. Microwave towers, spaced about twenty-five miles apart, transmit data or voice using electromagnetic waves in the radio-frequency spectrum. This method eliminates communications lines between sending and receiving points. However, the towers must be in line of sight with each other.

Cellular telephones should not be confused with **cordless** phones that operate on short frequencies in the home or office to an inexpensive link. Cellular instruments connect over longer distances to expensive radio transmitters and computers. Their service areas are known as **cells** linking up to networks. As the cellular phones become smaller and smaller, they are also becoming smarter. Growth in the number of cellular subscribers has increased beyond anticipation. Cellular manufacturers are putting modems into their products, making it possible to attach a portable computer. Because some cellular manufacturers use analog and others use digital, customers are being advised to buy dual mode phones that can work with either. The industry is perfecting global cellular coverage, a world-wide dial tone, for a customer to be reached anywhere (Weber 1992).

Of special interest was the launching of **North American Cellular Network (NACN)** by the McCaw Company. (AT&T purchased McCaw Cellular during 1994.) A problem is that there were no standards for the 734 territories outlined originally by the Federal Communications Commission for cellular development. As a result, many have different rates and methods for connecting to their networks. Many of these territories have been purchased and consolidated. For example, the industry describes the use of a cellular phone outside your local service area as **roaming**. When driving across the country on an Interstate, as a **Cellular One** (the McCaw Company) user, you can use your phone in more than 400 cities (areas or cells). In many other areas, Cellular One has agreements permitting the use of their facilities. Some state highways post cellular emergency numbers instead of the older CB radio code (Ramirez 1993).

There are two national wireless digital networks: **Ardis**, a joint venture by IBM and Motorola, Inc., and **RAM Mobile Data**, owned by BellSouth, Corporation and RAM Broadcasting Corporation of Woodbridge, NJ. These two wireless networks handle only data and are restricted to metropolitan areas. The McCaw Company is reported to be developing a more comprehensive wireless data network, called **cellular digital packet data, or CDPD**. The plan is for the CDPD to overlap its existing analog cellular system (Hill and Carlton 1994).

The National Information Infrastructure envisions "a new family of wireless services, [that] could create as many as 300,000 jobs in the next 10-15 years. The development of this industry will be accelerated by the Emerging Telecommunications Technology Act, which was signed by President Clinton as part of the budget package," (NII 1993).

Cable TV vs the Telephone Industry

By early 1992, 30 cable television companies had obtained federal licenses to build experimental wireless telephone networks to link cellular telephones through tiny radio relay stations. Other cable companies have been buying small companies that compete head-to-head with telephone companies. The cable industry is convinced that **cable** does not mean just **television** (Andrews 1992). The competition between the cable TV and the telephone industries continues to be interesting to watch.

Because TV and computer screens look so much alike, it is hard to realize that they are very similar in function, but the computer monitor is a much higher-performance item. A typical television screen displays 525 lines of data irregardless of the size of the screen. A typical super VGA computer screen displays 768 lines, with many having a resolution of 1024 vertical lines and 768 horizontal lines of **pixels**. According to Patrick Marshall, the real incompatibility between televisions and computer displays is in the transmission signals (Marshall 1994).

The fully digital nationwide network is expected to replace much of what has been described as major information resources using CD-ROMs and similar CD applications. According to **John C. Malone**, CEO of **Tele-Communications Inc.**, America's largest cable company, he points out that the information superhighway could render the CD-ROM obsolete through random access for customers to movies and most anything currently on CD-ROMs. However, for the immediate future, it is apparent that the CD-ROM technology is in place, and the networks envisioned are yet to be put in place (Schwartz 1993).

According to **Mitch Betts**, interactive TV is gambling that the public will pay more for their entertainment. He calls it a $30 billion question as to whether interactive TV will be the big flop that videotext was in the 1970s and 1980s. In the same article, he points out that **Steven Siech** of Link Resources Corporation, is very frightened that there is going to be a huge gap between the expectations that are being created and what the interactive TV industry is going to be able to deliver in the next five years (Betts 1993).

From the public's viewpoint, what is needed is a system that will permit TVs to be connected to a network that works like the telephone system, but large or wide enough to carry TV signals. This communications system must have software and sufficient switching capability to allow movies to go back and forth without breaks in the action, even when many viewers want to see them at the same or at different times. The screens must be sharp enough to display video in true color with text that is readable (Elmer-Dewitt 1994a).

Cross over--phone companies into video, cable companies into phones, is beginning to happen. **Andrew Kupfer** declares **convergence at last**: with cable company **Time Warner** offering phone service in western New York while **Bell Atlantic** serves up video in New Jersey (Kupfer 1994).

Another interesting competitor for cable TV is the expanding **Small Dish TV** concept that uses small satellite dishes to transmit TV programs with an increase in number of channels available. At this writing the cost, including installation, is just under $1,000, with monthly price similar to cable TV.

Multimedia and Communications

A major use of CD-ROMs is for educational materials, referred to as **interactive multimedia**. Special equipment is required for using multimedia in classroom environments. Many schools now have a few classrooms so equipped. The expense is a major factor. The ability to move the multimedia formats from one position to another requires more capable communications equipment than can be found on many campuses. Meeting these requirements involves additional expense. These special requirements for additional classroom and communications equipment are responsible for the slow implementation of multimedia resources in most colleges and universities.

Many learning institutions are developing plans and projects to expand the existing campus communications systems beyond textual transfer capabilities to include audio, image, and video multimedia in a cost-effective manner.

An example of the current ability to move an enormous quantity of information is the content of the 33-volume **Encyclopedia Britannica**. Using the telephone network of 1970, it took 84 hours to send all this information between locations. Using the switching mode in use today, that time is reduced to 13 hours. BellSouth Corporation's North Carolina Information Highway uses a switching mode called **Asynchronous Transfer Mode (ATM)**. Using ATM switching allows the transfer of the information in a mere 4.7 seconds (Clendenin 1993). CD-ROMs are used for applications never envisioned a few years ago. For example, IBM used CD-ROM format as one means of distributing its OS/2 2.1 operating system upgrade to users in 1993. Users requesting this format needed to have a CD-ROM reader on their personal computers to copy the programs into their machines.

According to **Ted Lewis**, editor-in-chief of Computer the IEEE monthly magazine, 1984 was a startling year because of the introduction of the Macintosh. He sees a similarity for the computer industry in 1994 as we enter the unknown and uncertain future, an **all-digital future**. Lewis believes that 1994 marks the beginning of a new era in computing and one in which communications plays a major role (Lewis 1994a).

GLOBAL COMMUNICATIONS

There are many efforts underway to form global communications alliances. The merger of **Viacom** with **Paramount** and **Blockbuster** is one example. According to a recent announcement in an advertisement, **MCI** is joining **British Telecommunications**

resulting in a company called **Concert**, short for **Concert Communications Company**. Their joint effort is to bring businesses around the world a better way to communicate (WSJ 1994). Vice President Gore, in his address on **Telecommunications Issues** before the National Press Club last year, set the stage for further action for the NII (Gore 1993).

COMMUNICATIONS INDUSTRY HIGHLIGHTS

Andy Grove, President and CEO of Intel Corporation, observes that in the next two or three years a new generation of high-speed communications links will change the way people work and communicate. High-speed PC modems are still limited to simple text documents. Grove says that **ISDN (Integrated Services Digital Network)** runs about ten times faster than existing modems. (After many false starts, ISDN is becoming available to residential customers in many paarts of the country.) In addition, Grove feels that the **desktop management interface (DMI)** will remedy the LAN problems by providing a cross-industry mechanism enabling the different parts of a network to work together regardless of their vendors (Grove 1994).

A decade ago the microcomputer arrived; however, the demand to transmit information became more complicated due to the need to "pump everything--voice, data, video, E-mail, and faxes through the same pipe--rather than using separate connections," according to **Vinton Cerf**. Dr. Cerf was the principal engineer of **MCI Mail**, one of the largest E-mail systems. Although known as the "Father of the Internet," he has returned to MCI where a major effort is underway to install high-speed switching, fiber-optic, and wireless transmission systems, with the eventual aim of developing a new local phone network that will meld with existing long-distance voice and data services (Hafner 1994).

The communications industry should profit from its historical experiences during the transition as wireless telegraphy developed into radio broadcasting and later into television. This development was recently documented in a TV program "**Empire of the Air**" produced by **Ken Burns** and underwritten by General Motors, the Corporation for Public Broadcasting, and the National Endowment for the Humanities. Unless national leadership is demonstrated to guide development of the transmission of multimedia, the taxpayers can be deprived of technical breakthroughs similar to their inability to enjoy **FM (frequency modulation)** transmissions to the fullest extent in radio and later in television (Empire of the Air 1991).

As **Robert Kahn**, who worked with **Vinton Cerf** on TCP/IP, points out, there is a major continuing set of roles and responsibilities for government bodies to undertake. Kahn feels that governments must architect the way in which different countries cooperate on various aspects of the Internet. He fears that without such a role by the U.S., it is doubtful that the NII will become a reality (Kahn 1994).

4. COMPUTER INDUSTRY

Within my lifetime, the computer industry has developed into one of the leading industries throughout the world. Like other industries, there are sub-industries that make up the computer industry. Two major divisions are **hardware** and **software**. Hardware refers to the computer equipment itself, with a separate grouping of **peripherals** such as printers, plotters, scanners, and other items separate from the computer or **CPU** (central processing unit). The software industry includes the programs or computer instructions for their operation. Another term, **firmware**, applies to software permanently stored in computer circuitry.

USA LEADERSHIP

Of major concern is the ability to retain the world leadership this country has developed in the computer industry. Following IBM's introduction of the **personal computer** in 1981, the year 1982 marked Time magazine's recognition of the computer, instead of a human, as "**Man of the Year.**" The year 1982 also marked the announcement to the world that Japan's **Ministry of International Trade and Industry** (**MITI**), during the previous fall, had developed a national plan to replace the United States in world computer leadership. This plan is referred to as the **Fifth Generation**. Although not accomplished within the ten years projected by the plan, Japanese competition is well known, having been demonstrated in autos, cameras, TVs, VCRs, and other items.

David Kahaner provided a condensation of a longer status report on Japanese high-performance computing in a recent Computer magazine article. According to Kahaner, the Japanese telephone company has committed to installing optical cable to every home in Japan by the year 2015 (Kahaner 1994).

The computer industry in America was fortunate in having as a foundation an extensive **punched card industry** on which to grow. The first commercial **mainframe** computer was the **UNIVAC I** (UNIVersal Automatic Computer) purchased in 1951 by the Bureau of the Census to process the 1950 Census data. (The merger of UNIVAC and Burroughs made up the company known today as UNISIS.) The new Census computer replaced the much slower and far less capable IBM punched card equipment. In spite of the success of the UNIVAC I, IBM, the leader in punched card equipment, became the leading computer vendor within two years. All IBM had to do was to educate its manufacturing and sales forces in computers, and its service force in their repair (Rosen 1971).

It was not until after vacuum tubes, identifying the **first generation** of computers, were replaced by **transistors** that demand for academic computer instruction increased. Transistors, small, solid state, semiconducting devices, identified the **second generation** of computers. This period extended from the mid-1950s until 1964. IBM developed two leading second-generation computers, the IBM 1401 and the IBM 1620, made available at reduced prices to academic institutions. The IBM 1401 supported business and administrative applications; the IBM 1620 supported scientific and mathematical work. An estimated 10,000 of each were manufactured.

Due to their increased speed, the early computers were far more capable than punched card equipment for performing **exception reporting** applications. Exceptions are, for example, the number of actual items in an inventory below or above an amount set as the level to be maintained. Initially, little use was made of computers for **management by exception**. For many years computers continued to turn out lengthy summary reports, only faster than their punched card machine ancestors. As a result, offices became inundated with stacks of detailed computer printed listings. The latest trend in the business world is for the vendors or suppliers of items for a production line or items for resale to maintain the customer's inventory at specified levels. These levels are, in most instances, minimal, because the user's efforts are to maintain **just-in-time (JIT)** stockage. This means that no inventory is maintained, i.e. items are to arrive as they are used or sold. Unfortunately, implementation is often opposed because individuals feel more confident when they are able to squirrel away a few items for emergencies.

By 1963, according to the late **Thomas J. Watson Jr.**, Burroughs, General Electric, Honeywell, RCA, and Univac had competitive machines superior to the existing IBM line. Several offered two or three times the performance of the IBM machines for the same price (Watson and Petre 1990, 350). The competition caused IBM to undertake what resulted in a **$5 billion gamble** to phase out all its then current computer products and replace the entire line with the System/360 computers (Wise 1966).

IBM's April 1964 announcement of its System/360 family of computers introduced the **third generation**. For the first time, a computer generation was identified by a combination of **hardware** (the equipment) and **software** (the instructions), rather than by hardware alone (Denning 1971). The third generation provided significant increases in processing speed or **throughput**, the amount of work accomplished during a given period. For several years, a System/360 computer on campus was a drawing card to attract new faculty and students.

Fifty years ago, a computer center with a single computer required a whole room of equipment. Initially, computer operators were walking around inside the computer setting switches as a form of what is well known today as **programming**. This time period was during the mid-1940s. Since that time, large mainframe computers are sharing the workloads with minicomputers, personal computers, and workstations. Many large organizations rely on their networks more than on mainframe computers. The problem remains; how to divide the work between the mainframe and the workstations?

A recent report by the **General Accounting Office (GAO)** points out that the U.S. government has spent over $200 billion on computers and related information processing systems over the past 12 years, but **it is unclear what the public has received for its money**. The report's title is "Improving Mission Performance Through Strategic Information Management and Technology" (EDUPAGE 1994e).

INDUSTRY HIGHLIGHTS

Programming

Teaching programming has been a debatable subject for many years. Some of the most heated arguments have resulted from the subject of programming. In all fairness, it appears that students should be exposed to the problem-solving experiences that result from learning computer programming. The students also need sufficient programming understanding to decide whether or not they want to become professional programmers. Other programming resources are an appreciation of automatic code generation and the use of modules to eliminate reprogramming the same instructions. It is a joy to watch students use code generating software for the first time, after they have struggled through a semester or two learning a programming language like **COBOL** or **PASCAL**. Students must also understand that programming as a career is a profession. Because it is a profession, not everyone should attempt to be their own programmer.

Should students who have not chosen to be computer science or computer engineering majors be taught **programming**? This question has been one of major significance for many years. **Mitchel Resnick** and **Seymour Papert** question the value of learning computer programming as it is being taught today, and point out that we need to rethink how we introduce programming to students. In their opinion, students should write programs as a way to explore, experiment, and express themselves using new types of programming tools. This question is receiving attention within the Association for Computing Machinery (Soloway 1993). Other organizations need to evaluate the question.

When working as a graduate student at Stanford University, **Justin Kitch** developed a programming language suitable for school children as young as those in the third grade. The language was named **FUNdaMENTAL**, a most appropriate title (Kitch 1994). This language should receive further support and evaluation for solving the programming language question.

A good example of how programmers failed to plan ahead is in the date change requirements for the year 2000. The standard date format MM/DD/YY was not thought to be a faulty standard. In order to correct all the programs that use the standard, it is estimated that it will cost billions! Two-digits are used to store the year. As **Peter De Jager** points out, he was born in 1955 and to calculate his age in 1993, the computer subtracts 55 from 93 and determines that he is 38. Unfortunately, using the same date standard in the year 2000, the 55 would be subtracted from 00, and the computer would determine that he is -55 years old (De Jager 1993). There is hope that a less costly solution than rewriting all the programs that use the date standard will be found in the near future.

Another area, gaining in acceptance, is that of **Object Oriented Technology**. This concept applies, not only to programming and languages, but in other areas that **Ted Lewis** identifies as databases, software engineering, systems management, and object-oriented thinking in general (Lewis

1994c).

Client/Server, Distributed, and End-User Computing

End-user computing (EUC) is a phenomenon recognized during the 1980s. Using microcomputers to replace dumb terminals provided the major introduction for EUC. According to one study in corporate America, and more specifically the Grocery Manufacturers of America, over two-thirds of all application processing is performed on mainframe equipment, eighteen percent on minis, twelve percent on PCs/workstations, and two percent via time-sharing services. The IT professionals in these organizations predict a 75% increase in the processing share done on microcomputers. The study also showed that EUC has expanded into application areas formerly thought to be the exclusive domain of corporate information systems (McLean, Kappelman, and Thompson 1993).

The heading of this section could have been Data Administration and Distributed Data Processing, as **Gerald Bernbom** used in his CAUSE/EFFECT article on this subject. To paraphrase Bernbom, he pointed out that the discussion is really about distributed technology. He identified two threads of technology developing in parallel, the distributed database management system and client/server architecture working on the problem of distributed data processing. Bernbom also calls attention to the fact that distributed data processing is not decentralized data processing (Bernbom 1991).

There is a difference in the meaning of the terms **client/server** computing and **cooperative processing**. **David Friend** describes the difference as "where control of the application resides." For example, in a client/server environment, control resides on the server; in cooperative processing, the application is running on a host telling the workstation what to do. Friend also calls attention to the fact that cooperative processing applications work acceptably even over 2,400 baud lines whereas 9,600 is far too slow for most client/server applications (Friend 1992).

Richard D. Hackathorn is a recommended author on the subject of client/server computing. His book, Enterprise Database Connectivity, recognizes that database management is no longer a separate function, but that it has blended with data communications, creating the hybrid he calls Enterprise Database Connectivity. He includes a discussion of the **warehouse** defined as **a collection of data objects that have been packaged and inventoried for distribution to a business community**. He points out that the business community is assumed to be end users rather than application programmers. The end users are performing management-level business functions (Hackathorn 1993,xxi,252).

A summary of the client/server computing situation by the editor of Computerworld's Client/Server Journal says that everything seems to lay claim to being mission-critical, object-oriented, strategic, robust, and scalable. He also feels that these marketing terms, with their interweaving of wishful thinking and outright deception, have become so meaningless he

could apply them just as easily to his two dogs (Johnson 1994).

The U.S. should take notice that two years ago the German software maker **SAP** was virtually unknown outside Europe. It is now recognized as being number one in worldwide sales of its R/3 software for applications packages for client/server networks with sales expected to pass the $1 billion mark (EDUPAGE 1994g).

Reengineering

The most popular **buzz-word** in administrative computing is **reengineering**. In spite of many well-known pioneers in the reengineering field, such as **Charles Bachman**, the college administrators who are members of CAUSE seem to agree on the **Hammer & Champy** definition from their book Reengineering the Corporation (Hammer & Champy 1993). **Darrel Huish** from Arizona State University paraphrased their definition as fundamental rethinking and radical redesign of an entire business system, the processes, jobs, organizational structures, management systems, and values and beliefs. In Huish's opinion, the key words are FUNDAMENTAL rethinking, RADICAL redesign, and DRAMATIC improvements (Huish 1993). Reengineering continues to be an important consideration.

Two examples from **Mark Olson** at Columbia University show the application of reengineering; one with technology playing an enabling role, and one without. One example involved a **radical redesign** by the elimination of the **Bursar's** position, merging the office within another office, Student Financial Services, and re-conceived its mission and fundamental processes. The other example was the implementation of an **imaging system** in their undergraduate financial aid office. The image system "reads" (recognizing over 30 forms) the documents, updates the mainframe databases for document tracking, and "files" the documents in an electronic folder. According to Olson, measurable results have been most encouraging (Olson 1993).

Data Administration

The function of a **database administrator** (DBA) is recognized by most institutions using DBMS (database management system) software. (Note that the word database was formerly written as two words, data base.) The DBA is in charge of the database maintained by the DBMS. The **data administrator** (DA) is responsible for **metadata**, or data about data. The DA is a necessity in large organizations where multiple DBMS software are used, especially from different vendors. There may be some campus data administrators; however, none are known to the author.

Data dictionaries and directories have not been well maintained except where database management system (DBMS) software requires the use of a data dictionary. Some of these software packages use active data dictionaries, those that are updated by the software. Others use passive dictionaries, those updated manually. In spite of the work by many individuals, top college and university administrators do not seem to take the management of campus-wide data and information seriously.

The education industry needs guidance and leadership in the management of data and information, as well as the implementation

of client/server and end-user computing. The interest is demonstrated by the two CAUSE Constituent Groups, **Data Administration**, and **Administrative Systems Management**, both recognizing client/server computing as a major discussion subject. Another concerned group is the **Data Administration Management Association (DAMA) International**.

Some feel that the data dictionary concept has been completely absorbed within the architecture of a repository, as **Terry Moriarty** points out. He also feels the name **data dictionary** is a product whose time has passed (Moriarty 1993). As **Enterprise Database Connectivity**, **warehouse** concepts, and other solutions are better understood and implemented, improved methods should become available.

Supercomputers

The United States has dominated the **supercomputer** portion of the computer industry since the pioneering efforts of **Seymour Cray**. In 1963, Cray developed the **Control Data 6600** computer that surpassed the efforts of IBM to build the leading scientific computer. In 1993, the leadership in supercomputers was challenged by a dozen or more companies using massively parallel processors (**MPPS**). For example, the **Maui High Performance Computing Center (MHPCC)** is equipped with IBM's **PowerParallel System** that uses 400 massively parallel processors (Port and Mitchell 1994). Another challenge comes from the use of clusters of powerful workstations programmed to work together on supercomputer applications (Mitchell 1993). Cray is now building another supercomputer with 2 million processors (Anthes 1994b). The main problem remains to be software to make multiple processors work together. This was the major issue a decade ago with the use of the **ILLIAC IV**, a supercomputer sponsored by **ARPA** of the Department of Defense.

Microprocessors

Transistors not only replaced vacuum tubes in computer circuitry, but as **microprocessors** they replaced fractional horsepower electric motors, timers, and similar control devices. These microprocessors became common items in home appliances, manufacturing equipment, airplanes, automobiles, traffic lights, videogames, and office equipment. New applications are common.

Microcomputers

During the early 1970s, the Intel Corporation of Santa Clara, CA, a pioneer in integrated circuits, found that a very small computer could be designed around a microprocessor. These small computers, called microcomputers and personal computers, make up the **fourth generation of computers**. There is no recognized date for the transition from third- to fourth-generation computers, as there was to identify the third-generation.

Computers are recognized as a major ingredient of information technology. The ratios of microcomputers to students and to faculties have increased year after year. However, these expenditures on computer equipment have made only minor changes in the way education is conducted.

Personal Computers

The **Altair 8800**, in either assembled or unassembled kit form, opened the market for today's microcomputer industry. Several microcomputers were offered before the introduction of the **Apple** computer by Apple Computer, Inc. and the **TRS-80** from the Tandy Corporation. The microcomputer/personal computer industry of today did not appear until IBM introduced the **personal computer (PC)** in 1981. The IBM advertisements using a Charlie Chaplin impersonator to prove the computer's ease of use became distinctive.

One of the earliest software packages available for use on the PC was a spreadsheet called **Visicalc**. This spreadsheet was later outsold by **Lotus Development Corporation's Lotus 1-2-3**; however, the two software packages attracted many PC users and many competitors. Now the software market for personal computers is a major portion of the software industry.

Operating Systems

Within the personal computer portion of the computer industry, there continues to be competition among computer **operating systems**, the software that controls the computer. At one time, the **MS/DOS** operating system, originally designed by the Microsoft Corporation, was the accepted standard. Apple Computer's introduction of the **Macintosh** through global advertising during halftime of the 1984 Super Bowl will be remembered. Macintosh introduced an ease of use that added another level of design concept.

John Sculley of Apple Computer fame is reported to have admitted that his biggest regret was, according to Alan Deutschman, allowing Apple to guard its technical breakthrough jealously rather than licensing other computer makers to build Macintosh clones (Deutschman 1993). Since Sculley's departure this policy has been changed. By the end of 1994, **Acer**, a Taiwanese manufacturer of IBM clones is expected to have a Macintosh clone, with **System 7**, on the market (EDUPAGE 1994c). On 19 September 1994 Apple Computer Inc. announced a new licensing strategy with a new logo. However, with only approximately 10% of the PC market, most believe, according to **Kathy Rebello** that the change will be **too little, too late** (Rebello 1994).

The 1980s will be remembered for desktop publishing. The Macintosh computer deserves its recognition for introducing this type of graphics-based capability. One of the advantages credited to desktop publishing is the ability to provide a **What You See Is What You Get (WYSIWYG)** image.

The Macintosh uses a distinctive operating system called **System 7**. In an attempt to meet demands of the public for more user-friendly PCs, Microsoft developed **Windows** to compete with the Macintosh concept that pioneered the **GUI (Graphical User Interface)**. Microsoft worked with IBM in the early development of the **OS/2** operating system. IBM continues to develop OS/2 on its own with a new version called **Warp**, released during the fall of 1994. Microsoft is now marketing a competitive operating system, **Windows NT**, with another, code named **Chicago** and now called

Windows95, promised in 1995. **Taligent, Inc.** the joint venture of Apple Computer, Inc. and IBM, with **Hewlett-Packard** as a minority member, plans to have a distinctive operating system on the market in 1995. It will be interesting to see how this new system interfaces with **Taligent Application Environment (TAE)**, a software development product that lets users write an application once and have it run on multiple platforms (Ziegler 1994; Scannell 1994).

Another competitor is the **UNIX** operating system originated by **AT&T's** Bell Laboratories during the summer of 1969. The University of California at Berkeley was a major contributor for 19 years toward the development of UNIX. IBM has its own version of UNIX called **AIX/ESA**, and an AIX version for its **RISC System/6000**, a reduced instruction set midrange computer. The most reliable operating system for IBM mainframe computers continues to be IBM's MVS. IBM retained complete control over the core MVS product. In comparison, AT&T licensed UNIX to anyone who paid the fee, many of whom, including universities, added their own value. The consistency of UNIX is still limited to certain source code. There are at least twenty or more UNIX variants.

In June 1993, **Novell, Inc.** acquired UNIX Systems Laboratories from AT&T, and with it, ownership of UNIX system technology and the rights to the trademark UNIX. A summary of the intent is that, "Novell bought the UNIX system to lead the industry in unifying it, while increasing its openness and strengthening its value to customers through volume distribution," according to a Novell press release. "Our business objective is to extend the value of the UNIX system to the tens of millions of industry standard computers shipped with Intel processors" (NEWS 1993). In keeping with this policy, Novell, Inc. transferred its trademark rights and copyright for the UNIX operating system to **X/Open Company**, a nonprofit consortium that helps set industry standards (Lytle 1994).

The use of personal computers to replace mainframe computers and other advances in technology are changing the way whole industries operate. Examples can be found in retail distribution, insurance, health care, industrial design, marketing, and new product development (Magnet 1992). **Andrew Grove**, President and CEO of Intel Corporation, referred to in the previous chapter, describes the PC industry as a new computer industry. He bases this on PCs using largely common silicon components. Mainframes are built by vendors who use their own proprietary computer platforms. The major problem today, as Grove points out, is the integration of all the existing and developing PC networks (Grove 1993; Hadjian 1993). Vendor advertising uses **Intel Inside** to let the buyers know the circuitry used.

32-Bit Computing

After punched cards, Intel's 4-bit chip, the 4004 in 1971, was followed by an 8-bit 8080 chip and Motorola's 6800. These were followed by 16-bit chips from Intel, Motorola, and others, becoming the foundation for 32-bit computing. **Windows NT**, IBM's **OS/2**, and **System 7**, referenced previously, are the major

operating system contenders. However, as the competition increases it will require more time for the winner to be decided.

Portable, Lap-top, Palm-top, and PDAs

The early portable computers were really "**luggables**," too heavy to carry aboard an airplane. The palm-top and lap-top numenclatures have combined as **PDAs (personal digital assistants)**. An early example from **Hewlett-Packard** was the **95LX** palm-top that used Lotus 1-2-3 software. Other example PDAs include Apple Computer's **Newton**, and **AT&T's EO Personal Communicator**. After much publicity, the EO was discontinued and the Newton went back to the drawing boards.

By the end of 1992, the most popular (notebook) portable was Apple Computer's **PowerBook**, a five to seven pound product. Among other capabilities, the Powerbook was among the first to use an ingenious **trackball** instead of a mouse. The PowerBook is the heart of the **Macintosh Duo System** that eliminates the need to buy two computers, a portable and a desktop. The PowerBook can be inserted into the **Macintosh Duo Dock**, and instantly, the user has a complete Macintosh desktop system. The PowerBook uses the **Motorola 68030** processor chip (AppleFacts 1992). There are other similar docking systems on the market.

The latest PDA to enter the market (Fall, 1994) was **Sony's** new PDA called **Magic Link**. Although **Walter Mossberg** could not recommend this PDA to business people because there are still problems; however, he does feel most optimistic about the future as new products enter the marektplace (Mossberg 1994).

Among the many portable/laptop computers on the market, the IBM **Thinkpad** is a typical example. One of the early outstanding features of the Thinkpad was its color screen.

During 1993, Intel Corporation launched a new and improved computer chip called **Pentium**; and reported to be five times faster than the 486 chip, performing at 100 million instructions per second. Increases in transistor density is shown by the Intel 386 chip with about 275,000, the 486 about 1.2 million, and the Pentium 3.1 million transistors (Brandt 1993). It is unfortunate, but a flaw was found in the Pentium after millions were sold. The pressure from a major competitor, IBM, and the public, caused Intel to change its policy and replace the faulty chips for free.

In an effort to break Intel Corporation's dominance of the computer chip market, IBM, Apple Computer, Inc. and Motorola undertook a three-pronged effort to develop an improved chip of their own. The chip, known as **PowerPC**, was unveiled as more powerful than Intel's Pentium, for about half the price. In September 1993, IBM announced the use of the PowerPC chip in its **RISC System/6000** workstation computer. According to all reports, the competition among chip makers was most noticeable at both the **'93 & '94 Comdex** shows at Las Vegas.

Multimedia Computing

The rule of thumb for 1994 was **don't buy a PC without multimedia**. An accepted practice for desktops, multimedia is now available on mnay portable computers (Cortese 1994). **Fred Hofstetter**, from the University of Delaware, points out that

multimedia is a strategic industry in the information society. He believes that those nations that do not succeed in multimedia will be unable to compete in the new global economy in which citizens who cannot use multimedia computers for videoconferenceing, education, just-in-time training, home shopping, and online financial services will become disenfranchised (Hofstetter 1994).

COMPUTER/COMMUNICATIONS OVERLAP

The overlap of the computer and communications industries seems to become more obvious every day. Data are simply not very movable without the communications industry and, in turn, the communications industry needs the products from the computer industry to make it all happen. A current example involves the likelihood of **Electronic Data Systems (EDS)** merging with a major communications company. By combining the technical competence of both, it appears that the synergistic effect will result in a major competitor in both industries.

Hardware vendors are designing products to act as both computers and TVs displaying TV programs on the computer screens. For example, **Packard Bell** expects to market personal computers able to double as radios, TVs, telephones, and fax machines with stereo speakers and CD-ROM drives (EDUPAGE 1994b). Another is **Compaq Computer's Mr. PC Head** (McCartney 1994).

ENTERTAINMENT INDUSTRY

The Associated Press reported that Hollywood (the **movie and entertainment industry**) was very obvious in their participation at the COMDEX extravaganza where in 1993 over 175,000 attendees gathered to view new IT products. Unless you have attended a large exhibitor show in Las Vegas, it is hard to comprehend the products and people. The press estimated as many as 190,000 to 200,000 people in attendance at the COMDEX FALL '94. The products and vendors are representative of information technology, not just computers. Another reference to the entertainment industry being the new driver of technology advancement was made by **John Huey** in a Fortune magazine article entitled "Waking Up the New Economy" (Huey 1994).

COMPUTER INDUSTRY HIGHLIGHTS

Without question, the computer is the key resource in the information society; however, the other three industries, plus the entertainment industry, are also key factors. Becuase the NII is maturing in a multimedia environment, the computer industry must expedite its improved computing capability, including operating systems, software, and communications software to make it all work together. This means that the vast majority of the millions of personal computers and supporting networks require upgrading to make access to **World Wide Web**, or its sucessor, feasible. Students and taxpayers deserve a higher degree of user friendliness than available today. The **plug and play** promises for both hardware and software to make installation and configuration of PCs automatic has a long way to go.

5. EDUCATION INDUSTRY

To date, the education industry has failed to demonstrate sufficient de facto leadership to be recognized as the leader of the information society. As a result, the education industry is beholden to other industries for information technology tools and services. Computers and communications are designed for corporate America, with insufficient consideration given to the needs of students, American classrooms, or academic support. Most schools simply adopt or adapt the tools and systems intended for corporate America.

The press is littered with recommendations for school reform, voucher systems, learning revolutions, new American colleges, for-profit private schools and similar discussions. Two recent recommendations for the education industry are **Lewis Perelman's** Schools OUT, Hyperlearning, the New Technology, and the End of Education, and **Neil Postman's** Technopoly: The Surrender of Culture to Technology. In spite of these and many other studies and reports, the education industry continues to suffer from a lack of leadership. For example, over a decade ago, falling scores on Scholastic Aptitude Tests (SAT) and lack of mathematics and science students contributed to the conclusion that a better-educated generation of young people was needed (Feigenbaum and McCorduck 1983, 238). Since that time, the **SAT** and **ACT** (American College Test) score results continued to be questioned.

The invited attendees at Fortune's **Sixth Annual Education Summit** (1993) attempted, during the conference, to answer the question "Progress: How far have we come?". The nearly unanimous answer to the question was "Not nearly far enough." Former Deputy Secretary of Education **David Kearns** pointed out that there are programs out there that work and make a difference, but having 200 or 300 good schools are not enough. He does not think that they impact the issues discussed at the conference over the past six years (Perry 1993).

Grade Inflation

Grade inflation is a general charge today; studies prove that, in some cases, 70 to 90 percent of the grades awarded to students are As and Bs, and no Fs or Ds (Toby 1994). Grade inflation exists because the customers--prefer better grades. Very often they feel disdain for tough faculty members--ones who "hold the line." Students voice this in their faculty evaluations, most of which are made anonymously. As a result, students can make accusations without fear of recourse. Administrators often manipulate the intent of these evaluations by using them to the advantage or disadvantage of the faculty member. For example, perhaps seventeen evaluation forms will appear in the final appraisal of an instructor, yet the instructor watched twice that number being turned in. The seventeen used may be only those favorable, or solely those unfavorable, and the faculty member is without recourse. The bottom line is that **educators** are being forced into playing popularity games with their students because of the competitive

environment within the education industry. These games are condoned by the education system which ignores the need for students to be held accountable for their actions.

Is Teaching A Game?

Teaching often appears to be a game with the instructor holding most of the cards. Students are only given sufficient cards for the instructor to be accepted by the majority of the students, thus keeping the instructor in charge. Instructors soon learn to cover up their teaching techniques and make their actions plausible. Instead of teaching students how to develop knowledge in a subject area, instructors often hide the bits and pieces of true knowledge about a subject so that only the most adept (not necessarily the most scholarly) students are able to recall the information or apply the knowledge required to obtain correct answers. In other instances, these bits and pieces are nothing more than minutia rather than substance. A detailed review of many multiple-choice and true/false examinations will prove the point. Such examinations continue to be used because the results are easy to grade, by machine!

Scholars

Graduate students and a few undergraduate majors are recognized as scholars and treated accordingly. It appears that the number so recognized is much smaller than the number of scholars who could be identified and nurtured. Unfortunately, few undergraduates are identified as scholars. Their scholarly traits are most often not recognized until they reach graduate school. In these instances, faculty become mentors to the students and, jointly, they work toward the development of knowledge. A professor emeritus will probably admit to his or her identifying less than a half-dozen undergraduate scholars and only twice as many graduate scholars during a teaching career. Most of these scholars survived in spite of the system instead of being a product developed by the education system. Improved instruction in developing knowledge will help identify additional scholars.

INFORMATION TECHNOLOGY (IT)

Information technology (IT) is made up of computer hardware, software, communications, and information tools, skills, techniques, and methods. The IT tools used to support the information society do not always identify their industry of origin. For example, the telephone switch for campus voice-mail is a computer. The use of IT is common in a variety of functional areas throughout other industries such as agriculture, banking, and manufacturing. Today it is hard to find any school, discipline, industry, or occupation where IT is not involved. In many cases the application of IT has brought about a major change in the way commercial business is transacted. The education industry needs to find new ways to apply IT through improved methods of providing education.

One of the earliest examples of the applying IT was the **Pony Express**, organized over a hundred and thirty years ago. This private enterprise began operations in April 1860. A freighting firm (Russell, Majors and Waddell) started the Pony express to

carry messages of urgency and importance from St. Joseph, MO to Sacramento, CA. The Pony Express mail went from Sacramento to San Francisco via boat on the Sacramento River. The total route was a distance of nearly 2,000 miles. Prior to the Pony Express, it took 25 days for mail to go from rail's end to San Francisco. The record run via Pony Express involved carrying President Lincoln's inaugural address in seven days and a few hours. The cost was $5 a half-ounce. There were 190 stations, 500 horses, and more than 200 riders. The completion of the first transcontinental telegraph line in October 1861 caused termination of the Pony Express after only eighteen months of operation. The loss for the founders was more than $200,000. This is an example of how technology not only changed the way of doing business, but how it virtaully eliminated one way of doing business (Miller 1993).

A more recent example of how technology changes an industry is the use of CD-ROMs in publishing encyclopedias, described by **Gary Samuels**. First published 225 years ago in Edinburgh, Scotland, the **Encyclopedia Britannica** has long been recognized as a leader. With a well-organized sales force of over 2,000 individuals, with purchasers paying about $1,500 for the full set, and a sales commission of about $300, why change when CD-ROMs were introduced? The company, Encyclopedia Britannica in Chicago, bought **Compton's**, invested in the new CD-ROM technology, and watched its interactive version become a huge success. When Britannica sales began to plunge, the Compton Division was sold to the Chicago Tribune Company and Britannica agreed not to publish a competing multimedia version of its own encyclopedia for two years (Samuels 1994). Encyclopedia Britannica is now being made available on the Internet; however, presently limited to text material without the benefit of sound and video. A CD-ROM version of the Britannica entered the market in 1994.

Using Information Technology (IT)

PLATO (Programmed Logic for Automatic Teaching Operations) developed during the 1960s at the University of Illinois was a form of **computer assisted instruction (CAI)**. Many IT applications have changed the way education is conducted. One example is the operation of the legal profession and law school instruction. They now use **Computer Assisted Legal Research (CALR)** services. Most academic law school libraries use either **LEXIS** formerly from Mead Data Central and now from Reed Elsevier, or **WESTLAW** from West Publishing Company, or both. The same is true for law firms. These services enable a user to have access to a vast law library in the office with the ability to search thousands of volumes in a few seconds. By using key words likely to appear in the text of the information needed, the computer does the search of the database chosen. These services provide U.S. code and federal regulations, federal case law, state case law from all fifty states, plus the District of Columbia and Puerto Rico.

CALR services are major resources in the design and operation of the state-of-the-art **moot courtroom** at the **Marshall-Wythe School of Law** at the College of William & Mary. The courtroom boasts two large television screens, a computerized

transcription system, an automated videotaping system, and computers attached to the judge's bench, the witness stand, and the desks of the court clerk, the prosecutor, the defense lawyer, and each of eight jurors. The computers are used, anomg other things to connect to legal databases. The equipment was donated by corporate partners, including Dell Computer Corporation and the Stenograph Corporation. The high-tech courtroom is a joint project of the law school and the National Center for State Courts, a Williamsburg-based professional association for state-court judges. Distance learning is being evaluated for delivering continuing-education classes to lawyers at remote sites (DeLoughry 1993a).

Similar services are provided by these and other vendors to assist in other classrooms. For example, the services of **LEXIS** and **NEXIS** are also in schools of business to aid instruction in managerial accounting and in educating legal assistants. NEXIS is a full-text news service.

An example of an effort to improve teaching is the **CUPLE Project**, sponsored by the American Association of Physics Teachers at the University of Maryland and Rensselaer Polytechnic Institute. The project is for the development of a new curriculum for teaching physics. This curriculum incorporates the latest information technology tools and techniques. More specifically, the concept integrates many different packages such as laboratory experiments, instructional text material, and simulation into a complete course that can be modified by the faculty member using the material (Wilson, Jack 1993). Since **Jack Wilson's** presentation, the 1994 freshman physics students at Rensselaer, in at least one class, will not be required to sit through a single lecture. CUPLE is being made available to other colleges through Physics Academic Software, c/o Academic Software Library, Campus Box 8202, North Carolina State University, Raleigh, NC 27695-8202 (Bogaisky 1994). CUPLE is representative of the type of effort that the KDC needs to encourage and build on for incorporation into the concept of knowledge development.

Other examples where IT has been used to change the way instruction is being carried out are referenced by **G. Philip Cartwright** in his "**Teaching With Dynamic Technologies**" article in Change Magazine of Higher Learning. Professor Cartwright rightly identifies **Loreta Jones** and **Stan Smith** for their contributions in the discussions of academic technology in the EDUCOM Review article "**Can Multimedia Instruction Meet Our Expectations?**" in the January/February 1992 issue (Cartwright 1993).

Since 1989, the **Institute for Academic Technology (IAT)** at the University of North Carolina at Chapel Hill has been a pioneer in research and development of multimedia applications. The IAT is supported by a grant from IBM. Among the many applications that have grown out of IAT, one is in the area of foreign language. **Professor Jim Noblett** developed a concept he calls **French Screen Immersion Learning**. This multimedia-supported concept completely surrounds the student as the interaction is observed and carried on. This effort originated when Professor

Noblett was in the Department of Languages and Linguistics at Cornell University, and continued where he serves as a member of the Department of Romance Languages at the University of North Carolina at Chapel Hill and the Institute for Academic Technology. A similar project in the mathematics area was developed by **Dr. William H. Graves**, Associate Provost for Information Technology, University of North Carolina at Chapel Hill. Professor Graves is also Director of IAT. The IAT semester catalogs describe the program that gives hands-on experience in the advanced use of information technology. The education industry needs to take greater advantage of this facility.

Another example of the use of multimedia technology is in the area of music. **Professor Fred Hofstetter** has made numerous demonstrations and keynote speeches describing his developments using multimedia in the field of music. Professor Hofstetter is Associate Provost and Director of the Instructional Technology Center at the University of Delaware where he developed the **PODIUM hypermedia program** for IBM's multimedia solutions. The University of Delaware conducts frequent tours of its multimedia facilities and welcomes visitors from other institutions (Hofstetter 1992).

Professor Don Hardaway, a faculty member of the School of Business at St. Louis University presented his accomplishments in the advanced use of multimedia at both CAUSE'92 and CAUSE'93. He is very careful not to favor any vendor, but uses only what, to him, are the best products on the market. He developed a software program called **Teacher 2000** to illustrate how lectures can be conducted. Teacher 2000 offers the capability to use text, graphics, still video, animation, hypertext, and motion video. At the CAUSE'93, Hardaway demonstrated the results of his development work on a new **Statistics** text. The result is to become a **Digital Textbook** making use of the new concepts of his Teacher 2000 concept (Hardaway 1993).

A student package called **Social Statistics Using MicroCase** for introductory social statistics instruction has been on the market for some time. It is published by MicroCase Publishing Division of the MicroCase Corporation in Bellevue, WA.

STUDENTS ARE A MAJOR RESOURCE

The most valuable and least recognized resource within the education industry is the student. Unfortunately, students entering college do not meet a common level of accepted standards. Having a high school diploma means different things to different people. As a result, colleges must provide remedial courses in what the students failed to learn in high school. After students acquire some college experience, they are not recognized as resources on campus. Neither are the students recognized as resources by the education industry. Recognition comes after they become graduates or drop out to pursue their own concepts and ideas. One outstanding example is **William H. Gates III** who left college to become the founder and CEO of the Microsoft Corporation. There are numerous other examples of students who quit school to follow their own beliefs where

college administrators and faculties failed to recognize them. Thousands of graduates have proven their worth in their own endeavors; however, through improved recognition, these individuals, while still students, could contribute much more.

Creativity

Among students, it needs to be realized that the level of creativity is much higher than administrators and faculty members appreciate. Unfortunately, most of the creative students are written off as being eccentrics. All individuals have some creativity; most are never recognized because schools do not encourage the development of their potential. There are exceptions in some scientific areas, but the success of those rare students in general is the result of individual instructors, not a system for recognizing creativity. We are told that creativity can be taught. One of the few examples is a course taught by **Professor John Kao** at the Harvard Business School (Farnham 1994).

Foresight/Vision

There are many references to the need for vision in corporate America. According to **Hamel** and **Prahalad**, they prefer the word **foresight** to **vision** for a number of reasons. They point out that vision connotes a dream or an apparition. Also that there is more to industry foresight than a single blinding flash of insight. In their opinion, ndustry foresight is based on deep insights into trends in technology, demographics, regulation, and lifestyles that can be harnessed to rewrite industry rules and create new competitive space. They go on to observe that any vision that is not based on a solid factual foundation is likely to be fantastical (Hamel and Prahalad 1994). Students need to understand the difference.

Visualization

The discussion of vision should not be confused with **visualization**. Students can profit from learning about visualization in the management of data to provide information. For example, **Edward R. Tufte** is of the opinion that there is no such thing as information overload. According to Tufte, perhaps there is too much data, but not too much information. After authoring two books to demonstrate that visualization can merge seamlessly with text, Tufte is a recognized information designer using vision as the art of seeing the invisible. He demonstrated the concept by using **Charles Joseph Minard's** 1869 graph-map tracking Napoleon's 1812-13 march to and from Moscow. Minard's drawing was actually an anti-war poster (Patton 1992; Tufte, 1983, 1990, 1992).

The IEEE magazine COMPUTER revisits visualization and graphics technology every twelve to fifteen months. In the July 1994 issue it was pointed out by editor **Ted Lewis** that two-dimensional concepts must be upgraded to three-dimensional to truly benefit from virtual reality. To create a 3D virtual reality simulation a 3D-scanner is required, plus a 3-D printing capability or **AutoCAD** system that will design the output product (Lewis 1994b).

Guest editors and authors contributing to a special issue of the Journal of Intelligent Information Systems on **Visual Information Management Sysstems (VIMS)** are convinced that these systems are emerging as a new area in information technology bringing about a revolution in information management. The need for new techniques are emphasized along with their realization of the breadth of the problems to be solved. These problems should not detract from the benefits possible from VIMS applications (Ralescu and Jain 1994).

CAMPUS LIBRARIES

Libraries have long been recognized as the central resource for learning on all campuses. These campus libraries differ, as do the people who use them. In general, libraries are very sophisticated organizations that reach into a great variety of resources. This variety brings about different methods of access and retrieval. Professional librarians are noted for their kindness, willingness to be helpful to library users, their knowledge of subject areas, and search procedures. Their internal and external resources include on-line databases, portable databases (on CD/ROMs), and materials available in other libraries through inter-library loan, the **OCLC**. This effort originated as the **Ohio College Library Center (OCLC)** in Dublin, OH. The organization is now known as **Online Computer Library Center, Inc.**

The previous reference to the excessive amount of data and information available demonstrated the need for information filtering. Another approach worthy of note is called **knowledge management**, a concept that originated with **Richard E. Lucier** at Johns Hopkins University. The concept was later enhanced by Lucier after he relocated at UCSF (University of California, San Francisco). UCSF is the only University of California campus devoted to research, education, and service in the health sciences. The knowledge management concept was implemented as a more experimental and challenging role for the **Center for Knowledge Management**, a part of the UCSF library. This resulted in the library being positioned at the beginning of the scientific communication process. This process is for the purpose of building and maintaining specialized knowledge bases in unique collaborations with scientists (Lucier 1992).

The physical centralization of campus libraries is traditional. However, some common decentralizations are prevalent on many campuses with sub-libraries in schools of business, engineering, law, marine science, medicine, and others. These decentralized libraries are similar to special corporate libraries, but most often remain part of the campus library system. Because of limitations on space and funds for expansion of existing centralized library facilities, further **decentralization** appears inevitable. Advances in technology for improved storage, such as CD-ROMs and movement of data via networks, make decentralization appealing.

An additional consideration in support of decentralization of campus libraries is that most users of the data, because of

their knowledge and experience, are not contributing their full potential in the centralized environment. Decentralization is supported in many computer applications because the users know more about data resources and the information required than anyone. These are the same reasons for the increased recognition of end-user and client/server computing. Campus library systems, like public libraries, are also influenced by the traditional number of volumes in library holdings as the primary measurement tool for library evaluation, instead of the measurement of how well access to information is provided.

The **Wichita State University (WSU) Ablah Library** is referenced as an exemplary automated system that uses commercial software called **NOTIS** from Notis Systems, Inc. The WSU system is called LUIS/MDAS. The following indexes are available on CD-ROM: **ABI/INFORM, COMPENDEX, ERIC, GPO CAT/PAC, MEDLINE, MODERN LANGUAGE ASSOCIATION (MLA) INTERNATIONAL BIBLIOGRAPHY, AND PsycLIT**. The library also uses a **Multiple Database Access System (MDAS)** with indexes to periodical articles: **GSCI (General Science Index), HUMA (Humanities Index), READ (Reader's Guide Index), SOCI (Social Sciences Index)**, and **ARTI (Art Index)** (Fast 1994). The WSU Ablah Library also has a bibliographic reference to Government Documents since 1976. The system is able to cross-reference the documents with the library's call numbers letting users know where to find the documents. These library references will differ from one university library to another; however, availability of these resources is a modern requirement.

A resource of interest to students is the **Directory of National Helplines**, a guide to toll-free public service 800-numbers (Consumers Index 1994).

The earlier reference to library automation in Chapter 2 also applies to campus library systems. A single example is representative of the many campus libraries that should be recognized for their contribution as major campus resources. The Dartmouth College electronic library provided the foundation for its **DCIS (Dartmouth College Information System)** that grows year after year (Brentrup 1991). For example, the last report of the progress at Dartmouth was the expansion of the campus-wide information system beyond textual resources to include image, audio, and video media. This will provide a broad-based access to and support for multimedia for a large community of users in a cost-effective manner (Brentrup 1993).

The Commonwealth of Virginia is building a statewide **virtual library** linking the fifty-one public colleges and universities, funded with $5.2 million in state funds (EDUPAGE 1994h).

The development of **multimedia software** is underway at **Northwestern University's Institute for Learning Sciences**. With funding from the Pentagon and Andersen Consulting, the leading-edge software is aimed at creating an electronic, just-in-time teacher. This software gives students access to a video database of subject experts who relay stories to answer questions (EDUPAGE 1994f).

One problem is the selection of the vendor and the software

for use in library automation. An example of how serious this can be is a recent trip by two individuals from New Zealand to U.S.A. to shop for library automation software. After arriving in this country, there was no one place for them to go to obtain the results from comparative study and use of competing software and vendors. One reference giving descriptions is the Directory of Library Automation Software, Systems, and Services compiled and edited by **Pamela Cibbarelli** and published by Learned Information, Inc. A system of user ratings of library automation software is now published in **Computers and Libraries** and **OASIS**, the Newsletter of the Los Angeles Chapter of the American Society for Information Science. Future survey results will be published in Information Today (Cibbarelli 1994).

Elimination of **card catalogues** is a problem due to cost and time required. When all cards are not eliminated, the problem is in the space and maintenance for the cards retained for the older reference materials. For example, the outstanding **Yale University** library system has only 2.5 million of the 6 million titles on file in the electronic catalog. This includes everything acquired since 1977; however, as **Librarian Paul Constantine** says: "Scholarship didn't begin in 1977" (Fellman 1993).

DATA/INFORMATION OVERLOAD

The expanding volume of information during recent years is the result of advances in data handling and information technology. These advances have increased the speed and volume of data recording, reproduction, transmission, and amount of storage. Data, the term most often used in plural rather than singular, provides users with sources of information. The increasing number of formats for the storage of data provides an overload of data available for use as information. These formats include a variety of methods to store text data, numeric data, mathematical expressions, graphics, and multimedia including color, sound, and animation.

The body of medical knowledge required today far exceeds what students can learn in four years. The problem may reside in the learning process rather than in the teaching process. A recommended solution is the identification of a core of medical information that must be learned. **Dr. Gerald Burrow** writes that students must learn how to decide what information they require for decision-making. As the decision making complexity increases, algorithms will need to be applied. Medical students need to learn how to gain access to, but not necessarily learn, the information required to practice medicine (Burrow 1990). This involves **information filtering**, a subject recognized by a special issue of the Communications of the ACM (Loeb and Terry 1992).

Dean Burrow is not alone in his interest in making improvements in medical education. Medical schools in general realize the problems associated with the excessive amount of medical information. **C. Everett Koop**, the former U.S. Surgeon General, at the **Koop Institute, Dartmouth-Hitchcock Medical Center**, has undertaken a related project. This project is intended to expand the emphasis on primary-care making use of

computer and virtual reality linkups that will expand the range of a general practitioner's skills. Also, at the request of Vice President Gore, Dr. Koop has put together a group of leaders from the communications and computer fields to find ways to link patients, health-care practitioners, and medical centers. A prototype in New England is being started (Ryan 1994).

Each discipline and functional area has similar problems outlined above for the medical profession. The larger problem is an organizational problem, making proper use of information generated by separate functional areas for the use and betterment of the organization as a whole. Hospital management includes many functional areas in addition to the functions performed by physicians and surgeons.

CIOs IN ACADEMIA

As in corporate America, there is a reluctance to accept the designation of an individual as CIO to be responsible for the management of information in colleges and universities. A 1990 study of recognized academic institutions that defined the functions of the CIO concluded that not all colleges and universities want or need a CIO. However, the report did identify a potential need for such a person over the next decade of up to one-half of the colleges and universities in the country (Penrod, Dolence, and Douglas 1990). In spite of the CAUSE Institutional Database showing that approximately half of the schools reporting had an individual functioning as a CIO, less than a half-dozen of the 1,700 attendees at the CAUSE'93 conference listed CIO as their job title.

The solution is not in a CIO job title, but in the redirection of the position functions. This was discussed in Chapter 2. CIOs, directors of MIS, of IT, and individuals in positions with similar titles should fill staff positions. The professionals occupying these positions should be performing staff functions similar to other staff positions for human relations, budget, finance, etc. Their job is to insure that the organization as a whole is making the best possible use of information resources management including information technology. The functional area managers must be held responsible for the information management, including the computer supported applications that support their functions.

There are times when the IT manager must assume the responsibility for the design, development, implementation, operation, and management of computer supported applications. For example, when a college or university plans to move educational facilities into neighboring communities or downtown office buildings where classes will be offered by numerous departments, the IT manager should be given responsibility for such a move. After these facilities are well established, the primary operational and maintenance responsibility of the computer support should be turned over to the primary user.

Schools of business educate students in personnel management, but the human relations director does not manage the personnel in a plant. Comptrollers and financial officers are

technical staff positions; however, they do not manage the funds within an organization's functional area. Educating students to fulfill this role of IT management in their own functional areas does require an improved approach for the instruction presently available.

EDUCATION IN COMMUNICATIONS

Prior to deregulation of the communications industry, an organization leader could call on "**Ma Bell**" for help in solving problems in communications. The costs involved were within the regulated criteria. At present, over a decade since deregulation, the education industry continues to fail to provide sufficient instruction in communications. This lack of leadership has given commercial training organizations and consultants an opening to provide most of the available instruction. The education industry fails to educate the many directors of telecommunications required on campuses, in government agencies, and in the private sector. A greater problem is the failure to educate college students in the advantages and disadvantages of communications for their use in their life-long learning. As the communications networks improve, these resources become more readily available on an international basis. Students need to know how to take advantage of these resources and grow with their expansion.

Temares and **Zastrocky** had the data from the **CAUSE Institution Database (ID)** downloaded and merged with the results of their 1994 postcard data survey. The CAUSE Postcard Survey Service provides CAUSE members with a method of collecting specific information from member campuses and using the data in various research projects. The 1994 postcard survey was mailed to 1,012 institutions of higher learning in the U.S. and sent electronically via the Internet to eighty-one CAUSE international member campuses. The response rate was 51.7% with 565 completed postcards received. The 1994 survey identified **networking** and **coping with limited resources** as the two most critical issues facing higher education. These results followed very closely those from the previous survey. The identity of the two most critical items were generally the same regardless of size of the schools, public or private. The leading new issue was "**Aligning IT (information technology) with university goals**" ranking third, behind the two leading issues (Temares and Zastrocky 1994).

According to some research, there is a gap between what is taught and what is needed in the telecommunications education of information systems professionals. Other researchers reviewed the textbooks available to instructors who are planning a course in telecommunications. Half the texts dealt with purely technical issues. The remainder contained some discussion of management issues in connection with application maintenance. The emphasis is on technology from the viewpoint of electrical engineering and computer science, avoiding the need for an understanding of enterprise communications (Collins and Trauth 1993).

An example, showing the need for improved understanding of communications is **open systems**. **Bill Laberis**, editor-in-chief of Computerworld sums up the situation with: "The phrase 'open

systems' has become one of the more bastardized, loosely used and overused phrases in the business," (Laberis 1994).

A more pressing reason for updating the instruction in communications is based on the policy changes anticipated by the implementation of the **National Information Infrastructure**. This states that "the Administration will work with Congress to pass legislation by the end of 1994 that will increase competition and ensure universal access in communications markets -- particularly those, such as the cable television and local telephone markets, that have been dominated by monopolies. Such legislation will explicitly promote private sector infrastructure investment -- both by companies already in the market and those seeking entry" (NII 1993). The legislation is still to be enacted, but the need continues.

Students need to acquire an understanding of the existing Public Switched Telephone Network that provides the world-wide telephone service referenced previously. The communications education should also include an appreciation for the concept developed by **Robert Metcalf** after he read a paper by **Norman Abramson** in 1970 about the **AlohaNet**. AlohaNet was a packet radio system used for data communications among the Hawaiian Islands. By application of the AlohaNet concept Metcalf developed **Ethernet**, the dominant local area network. Examples of the advances of Ethernet include the capability to extend the range from two-miles to over seventy miles and of sending the signals over common telephone twisted pair (Gilder 1993).

ISDN (Integrated Services Digital Network) is a decade-old standard for digital telephone lines now coming on-line at 144 kilobits per second, but being aced by Ethernet over cable. According to **George Gilder, ATM (asynchronous transfer mode)** will blow away Ethernet during the next decade or so (Gilder 1993). Please note the previous references to ISDN and ATM in the discussion of communications in Chapter 3, pages 28 and 29.

It appears that the problems caused by the incompatibility of much of the IT hardware and communications software will continue. In an effort to solve the problems, new vendors appear frequently; older vendors are merging, going bankrupt, or going out of business. This constantly-changing environment with all vendors shouting that they have a solution to your problem, no matter what problem, adds to the confusion. The education industry must demonstrate leadership by providing the required instruction. A major resource supportive of the education industry is the **Institute of Electrical and Electronics Engineers, Inc. (IEEE)**. The inputs from the IEEE need to be integrated with other professional groups.

USE OF THE INTERNET

By connecting computers to the Internet, information technology comes to life, or so it seems at the **Ralph Bunch** public school in Harlem. This can only be appreciated after you have used the Internet. There are a number of network services that use a variety of methods to attract and hold the student's attention. One conclusion from the experience in Harlem is that

there is a need for teachers to make use of the capabilities now available (Corcoran 1993). Learning to use the Internet will prepare students, faculty, and administrators for membership in the knowledge society and the use of the NII. There seems to be agreement on the desirability of Internet utilization; however, the major concern is over how long it will take most schools to join the network and how sophisticated they will be about it. According to Robert Jacobson the Internet makes it relatively straightforward to transmit a signal 3,000 miles from one coast to another. He observes that the most difficult is the last 30 yards from the school office to the classroom (Jacobson 1994a).

The objective for all schools now is to be able to access the **World Wide Web** or something similar, permitting the flow of multimedia comparable to the access and movement of text material. Unfortunately, many do not realize the required upgrades in communications networks, software, and personal computers necessary to make this upgrade possible.

EDUCATION IN COMPUTING

Until the influx of microcomputers began replacing dumb terminals for accessing mainframes and the use of personal computers as workstations, campus computer administrators could contact IBM, DEC, UNISYS, or Hewlett-Packard for solutions to most of their computing problems. This was similar to the "Ma Bell" example in the discussion of education in communications.

Educational administrators who participate in software development often permit vendors to acquire most all the rewards from joint efforts. The education industry then tolerates their resale to other academic institutions. Those schools that develop their own software have only limited outlet for other schools to benefit from their efforts. There is no system for these dedicated schools to share what they have accomplished. Many of these **home-grown computer applications** are worthy of consideration and selection over many vendor-developed products. The education industry could help itself through proper leadership in making better use of applications development resources available on college and university campuses.

Computer science professionals and their courses have dominated education in computers for half a century. Just as electrical engineers have dominated the education instruction in communications, students have been forced into excessive technical knowledge of computers: how they are built, and how they work. Faculties in schools of business administration conducting courses in management information systems have been influenced in curricular issues by the **Association for Computing Machinery (ACM)** and the **Data Processing Management Association (DPMA)**. The **Society for Management Information Systems (SMIS)** changed its name to the **Society for Information Management (SIM)** in 1982. With the change in name came the domination of this former academic professional association by corporate MIS managers and CIOs. During the past decade, SIM's curricular influence has been on what corporate America would like to have graduates know instead of the education industry demonstrating

the leadership in outlining what should be taught. For business students this resulted in an overdose of **COBOL** and little instruction in the management of information as an organizational resource. Additional examples are credit courses, even in graduate school, for students to learn word processing or how to use a spread sheet, when most all software packages have built-in tutorials.

The ACM and DPMA guidelines for information systems courses have continued to follow the concepts of **Management Information Systems (MIS)** as described in the third edition (1993) of the Encyclopedia of Computer Science. The term management information system, or MIS, is cited as the most widely used title for a management-oriented information system. It is also pointed out that many organizations refer to their computer-based information system as a data processing system or information system (Davis 1993). No doubt these references are being updated to inclued items such as information resource management.

Computer instruction in American schools has been described as a **national hodgepodge**. It has also been pointed out that **confusion exists in teacher preparation**. These conclusions were reached by **Doris Lidke and David Moursund**, based on their experiences and observations from positions as program director of NSF's Division of Undergraduate Education and chief executive officer of the International Society for Technology in Education. The education industry does not seem to appreciate that computer programming is a profession. There are many different languages included since the educational system in the U.S. is highly localized and often compared to a cottage industry (Lidike and Moursund 1993).

According to **Paul Dobosh** in a discussion of computing problems in liberal arts colleges feels that there is need for graduate degree programs for computing administration. This refers to the education of campus computer center directors. In Paul Dobosh's opinion, he feels that graduate or terminal degree programs in computer science or information systems tend to train individuals for software development, theory building, research, teaching, systems analysis, or other areas of applied data processing (Dobosh 1992). This is a situation similar to the courses in telecommunications referenced previously.

It does appear that improvement is on the way. According to the latest report from **Blake Ives**, senior editor, MIS Quarterly, and **Robert Rubin**, president of SIM International, task forces have been appointed to explore information technology education. The MIS Quarterly will publish a future special issue devoted to information systems curricula and pedagogy (Ives and Rubin 1993).

The computer science faculties and students majoring in computer science have much to contribute toward the enhancement of computer-supported systems on campuses. **Professor Peter Denning**, the former president of the **Association for Computing Machinery (ACM)**, points out that computer scientists should embrace applications (Denning 1991). When the computer science students and faculties are involved in campus applications, their

contributions will be overwhelming. This involvement may require direct leadership from the school's top administrators to make it happen.

Students need to realize that the knowledge they obtain during college is only a foundation and that they must build on this foundation through life-long learning. Students can increase their ability to cultivate their visions through the use of what ***Professor Denning calls exhibitions of competent performance. His*** concept does not attempt to replace informational knowledge with actional knowledge, but recognizes the need for knowledge that can be gained only from involvement with others in the community who already know it (Denning 1992).

EDUCATION IN HOW TO USE AND MANAGE INFORMATION

The concept, known as **Information Resource Management** or **IRM**, originated with the Commission on Federal Paperwork that resulted in the Paperwork Reduction Act of 1980. The first text the author used in a 1980 IRM graduate course was written by **Forest Woody Horton, Jr.**, documenting the IRM concept he originated while working with the Commission (Horton 1979). The work of the Commission did not go unnoticed in the private sector. For example, at the McDonnell Douglas Corporation, **Ernie H. Ridenhour** was appointed staff vice president-information resource management in August 1980. Mr. Ridenhour was the mentor for my graduate IRM course that fall. Since that time, most courses and textbooks in information systems have continued to follow the older MIS concepts. This conclusion is based on a review of the course outlines published in the IAIM Syllabus Book (Neal, Ellis, and Chou 1993). Two additional references used are The EDUCOM/USC Survey of Desktop Computing in Higher Education (Green and Eastman 1994) and the Tenth Annual UCLA Survey of Business School Computer Usage: A Global Perspective (Frand, Britt, and Ng 1993).

Students need to learn how to use information as individuals as well as the management of information as an organizational resource. The knowledge gained will prove useful for all courses and for life-long learning. This involves learning about information resources, how to find, access, evaluate the data, select the information needed, then organize the results for future knowledge development.

Learning about the management of information involves the campus organization for information management and information technology. Where schools have not yet recognized the value of information as a resource, this instruction will be of help to the school as well. The school's strategic plan for information technology, is expected to be integrated within the campus overall strategic plan. This plan should be available for student use in their understanding of information management.

By making use of student team organizations as well as students working as individuals, they will learn advantages and disadvantages for information organization and use. It has been recognized that students learn much from each other in any educational environment.

Executive Information Systems (EIS)

The education industry makes extensive use of information technology for administrative and academic support. In the majority of cases, the technology has been applied by the automation of existing functions. Automation, applied on a functional basis, has made it hard to obtain the needed information for the support of the campus as a whole. For example, instruction in **executive information systems (EIS)** is meager, found in only a few courses. Neither does the education industry provide working examples of EIS applications on campuses. The most recent CAUSE Institutional Database Survey reported that 21 percent of the schools responding had an EIS in use or one was being implemented (CAUSE ID 1993). The examples available to the author are in the **being implemented** category, or as automated briefing books instead of true EIS applications.

Administrators and Faculty

The administrators and faculties of our colleges and universities are the envy of the world. This fact is proven by the nearly half-million foreign students who come to this country to attend our universities. A high percentage of doctorates go to foreign-born students.

In spite of this reputation, much can be gained through improved relations between **administrative and academic computing** on college campuses. There is a cleavage between administrative and academic computing, a recognition of cultural differences that, according to **Jane Ryland**, make a common organizational structure stressful and thus inappropriate (Ryland 1992). This may be a valid point of view; however, it should not detract from the need for emphasis on increased cooperation by the two groups, and less attention to organizational structures. According to the **CAUSE Institutional Database Survey** 55 percent of the schools reporting have combined academic and administrative computing, and in 45 percent, they remain separate (CAUSE ID 1993).

There is a large amount of untapped IT knowledge within the computer science, engineering, business administration, and other departments. This knowledge can be applied to the computer applications on campus in support of functional areas. Administrators can also make contributions toward improved use of IT in classroom instruction. It seems unfortunate that many senior administrators seem resigned to the concept that they cannot reengineer a process that they do not control. However, the top school administrators are in control; they simply do not exert sufficient leadership in dictating what goes on in the classroom. For example, how many college presidents and chancellors visit classes in progress? Visits by other faculty are also lacking, even classroom visits by department heads. This lack of sharing hurts students in the long run.

APPLICATIONS DEVELOPMENT AND MANAGEMENT

Historically, computer center managers have been responsible for the design, development, test, implemention, operation, and maintenance of functional area systems. This method of application development grew out of the early punched card data

processing systems when it was nearly impossible to interest functional area managers in using punched cards to support their areas. As a result, those of us who were data processing managers designed, developed, and operated the applications for the functional area managers. Many times these systems were not accepted by the users because their employees preferred to continue to use their old manual methods.

School instruction has stressed information technology (IT) tools and skills for the past fifty years. This has resulted in most computer applications being developed as **stove pipe systems**, designed for the support of functional areas instead of for the operation of the organization as a whole. In addition to computer center managers and their IT professionals perfecting the computer applications, a large group of vendors and consultants have appeared who specialize in computer systems and applications development under a variety of marketing terms.

The problem today is that it is the exception for functional area managers and end-users to take a leadership role in application development. When they do assume leadership roles, the IT professionals will be able to advance their technical knowledge and support, spending more time on the leading edge of information technology in its multimedia environment. The functional area managers and their end-users must be educated in order to perform their expected role in applications development and management. Educating students on campus will help.

For example, business students who are to become managers are educated in accounting, quantitative analysis, economics, legal environment, mathematics, statistics, marketing, finance, management including organizational behavior, human resources, and production. These students are exposed to only a smattering of management information systems that for many years was primarily computer programming and how computer equipment and peripherals operate.

Students are not encouraged to study existing campus functional area support applications. Neither are faculties who teach about information technology encouraged to become involved with the design, development, and operation of campus systems. There are some exceptions, but in the majority of cases the line is still drawn between academic and administrative computing even when they are housed and supervised within the same organization.

Development of Applications Software

During the past half-century, colleges and universities have been recognized for many contributions in the development of computer applications. For example, the concept of **CASE (Computer Assisted Systems Engineering)** tools was introduced by **Professor Daniel Teichrow** at CASE Institute of Technology (Dennis et al. 1988). Professor Teichrow's early development established the foundation for the **electronic meeting system (EMS)** implemented under the leadership of **Professor Jay F. Nunamaker** at the University of Arizona. Nunamaker is also CEO of the Ventana Corporation in Tucson, the marketing and development firm for the EMS software **GroupSystems V**. IBM has a licensing agreement with

Nunamaker's Ventana company to market a version of the software as IBM's TeamFocus (Kirkpatrick 1992).

Instead of the education industry continuing its role of leadership, commercial vendors now dominate the market with design methods priced above most school budgets. This makes it all the more urgent for the education industry to reenter the arena to meet school needs. The education industry can learn much from the research and development work underway to support the **North American Aerospace Defense Command (NORAD).**

During the 1960s, the NORAD headquarters was relocated from a vulnerable building in Colorado Springs, Colorado to the granite-shielded security of Cheyenne Mountain. This hollowed-out mountain in the Colorado Rockies on the eastern slope of the Continental Divide is now the nerve center for sounding the initial alarm of an attack against North America. In spite of the reduced threat from the former Soviet Union, the possibility of nuclear weapons falling into the hands of terrorists makes the threat greater than ever. It is more alarming because most American taxpayers do not realize that NORAD lacks the capability to shoot down intercontinental ballistic missiles like the Patriots did to the scud missiles from Iraq.

In 1985, the United States Space Command (USSPACECOM) was activated to consolidate all military space efforts under the direction of one commander-in-chief directly responsible to the President through the Secretary of Defense and Chairman, Joint Chiefs of Staff. As a unified command of the Department of Defense, USSPACECOM is located at Peterson Air Force Base, Colorado Springs, CO. There are three subordinate space commands from the Air Force, Army and Navy.

The systems in use within the mountain were developed independently over a number of years. These computer applications are also called **stove pipe systems**, because they support a single functional area. These old design methods required the integration of the applications, after their implementation. In spite of the problems of integrating systems using twenty-five or more different programming languages, an integrated world-wide network of missile warning, space surveillance, and air defense system is in place. An anti-narcotics effort to detect and monitor aerial narcotics traffickers has been added to the NORAD mission.

At the time of their development, commercial database management systems and other software would not meet the operational requirements to support the applications in the mountain. As a result, the software used is really hand-coded in order to provide for the reaction time required for the evaluations prior to the necessary warning. The rapid advances of technology cause a continuing effort to upgrade the systems. A complete upgrade for all computer applications is in progress. By 1996, the new systems and applications used in **Cheyenne Mountain** will be more distributed, and more work station intensive, and less monolithic. The equipment in the **NORAD Command Center** was upgraded during August 1991.

The Department of Defense established a standard procedure for the development of Mission-Critical Computer System software in 1985. An improved version, DOD-STD 2167A, was published in 1988. The standard is for use by external defense contractors and military development organizations. The original version of the standard followed the waterfall development cycle of analysis, early design, detailed design, programming, testing, and implementation. The revision permits the contractor to select the process model to use, with approval. In spite of the improvements, there is agreement that too much paperwork is involved. However, the 2167A standard is really a tailorable document. It imposes a much needed discipline for all to insure orderly development of the systems. The organization requiring the use of the standard must be sufficiently knowledgeable in the application to gain the best results for all concerned.

No record has been located where the Department of Education has made an effort to develop a similar standard for the education industry. The educational institutions across the land have a wide variety of complex systems developed to support functional areas using a multitude of programming languages. The 1991 Department of Defense Appropriations Act requires the use of a single programming language, ADA, unless a waiver is granted. Apparently, few waivers are being granted today in view of the wide acceptance of ADA among contractors and users. A similar standard could be beneficial for the education industry, eliminating much of the redundant development efforts that exist today. The standard for developing educational applications should provide for the documentation to be automated, eliminating the volume of paperwork required by DOD-STD 2167A.

The responsibility for the maintenance, backup, and development of new and improved computer applications used in support of the operations center in Cheyenne Mountain is performed by the Space and Warning Systems Center (SWSC). The SWSC organization is a subordinate unit of the Air Force Space Command, referenced above. Computers are the aircraft of the Space and Warning Systems Center. This command is the repository for the knowledge about the system of computer systems used within the mountain and in the world-wide network of data gathering. Less than a thousand personnel (military, civilian, and contract employees), keep all the computer applications operational for the entire Air Force Space Command. The actual computer operations are carried out by the personnel assigned to the mountain, a separate group. However, operating experience in the mountain is valuable as confirmed by the present commander who spent the last two years in the mountain in charge of operations. A small work group from the SWSC is located inside the mountain as a coordinating point for applications and systems maintenance. All systems and applications operated within the mountain are duplicated in two buildings of the SWSC at Peterson AFB and in the Federal Building in downtown Colorado Springs, CO. These provide for maintenance to be performed on the backup systems and equipment.

Colonel James J. Romanchek and the members of SWSC conducted an applications overhead study of one of the operational systems that used between 2.2 and 2.5 million lines of programming code. The intent of the study was to identify what portion of the code provided the algorithms used to perform the actual computer processing. This was determined to be approximately 200,000 lines of code, less than ten percent of the total. The remaining code, amounting to about 2 million lines, provides systems services, channeling, data management, user interface for the displays, and other support function. The results disclosed that approximately 90 percent of the software code in this application was used for application support.

Another, smaller application, involving a total of about 320,000 lines of programming code was selected for a similar study. The results showed that only between twenty and thirty thousand lines of code performed all the operational computer processing. The remainder of the code was for system services and other support functions. This system was operating on hardware from a different vendor. The services performed varied due to the design architecture of the hardware; however, the ratio of approximately 80 to 20 percent remained. Subsequent evaluations of all the major systems used in the Cheyenne Mountain complex, including those in the upgrade, remained within the 80 to 20 percent or less ratio.

The **conclusions** from these studies led Colonel Romanchek to reason that a common software infrastructure was needed for every system used in the mountain. The concept for the common software is to handle the systems services, channeling, data management, user interface for the displays, and other support functions. The concept becomes the **API** or **application program interface** for all the applications used in the mountain. The current term for the concept is **megaprogramming**. Colonel Romanchek says that megaprogramming is defined by the **DOD STARS** (Software Technology for Adaptable, Reliable Systems) program as "process-driven, domain-specific reuse based, technology supported" software development. This will relieve the applications programmers and systems analysts from concern about the support of their applications. The programmers and systems analysts professionals can concentrate on the design and development of the code for the actual computer computations and avoid the drudgery of the overhead requirements. The SWSC is continuing the development under the leadership of **Canadian Lt. Colonel Dave Bristow** (NORAD 1992; Romanchek 1993; Bristow 1994).

A number of vendors provide CASE tools for academic use. One of the early tools used in the classroom is **Excelerator**, originally provided by Index Technology Corporation and now by Intersolv, Inc. Another major contributor has been **Andersen Consulting's** support of academic efforts including a Foundations of Business Systems textbook and software (Flatten 1992). **Texas Instruments Incorporated** has an excellent track record for supplying **TI's CASE** product, the **Information Engineering Facility (IEF)**.

The education industry needs to take better advantage of the developments of **object-oriented** technology. **Ted Lewis**, the editor of Computer, identifies three major problems in software development: the need for rapid, incremental, iterative development of new systems; the need to capitalize software and thus encourage reuse of proven components; and the need to reduce postdelivery maintenance. Professor Lewis further explains that the object technology achieves rapid development through a mechanism called **inheritance**, in that new pieces of code inherit their behaviors from existing (reusable) designs and codes. He emphasises that **design** is reused, not simply the code; therefore, **design is the key** (Lewis 1994c).

In the previous discussion of operating systems in Chapter 4 a reference was made to Tailgent, Inc., the joint effort by Apple, IBM, and Hewlett-Packard. The **Tailgent Application Environment (TAE)** software under development is an attempt to carry out the above concept by letting users write an application once and have it run on multiple platforms.

Another effort the education industry can learn from is the **Australian** development of a national approach to management and administrative computing in higher education (Manage IT 1993). The group is called **CASMAC (Core Australian Specification for Management and Administrative Computing)**, and is developing system specifications in the areas of student records, research and consultancy, human resources, physical resources, and finance. The CASMAC project targets areas of commonality and expects to address at least 80 percent of the university management and administrative needs (Brown 1993). According to **Professor Robin McDonough** the Australian effort originated in the United Kingdom where it is continuing (McDonough 1993).

EDUCATIONAL COMPETITION

The major competitors of the education industry are the Department of Labor, vendors, professional trainers, trade associations, labor unions, consultants, and corporations. The corporations have been recognized as major providers of adult education (Eurich 1990,60). Many vendors demand that college professors who are admitted to their courses sign nondisclosure agreements. In some cases, the confidentiality obligations assumed by the signature continue for as much as five years (TI 1992). These nondisclosure policies protect the vendor's academic instruction base as an income-producing facility. From the corporate viewpoint, these requirements are justified. From an educator's viewpoint, the education industry should be the developer of the original concepts and not beholden to corporate America for leadership. Many of the concepts subject to nondisclosure agreements originated during joint development with individuals from academic institutions. However, the education industry fails to protect its member schools.

A specific example of vendor education in competition with academic America is the software firm Information Builders Incorporated (IBI). Until 1979, only a few classes were held in the firm's New York offices. Since that time, the firm now offers

close to 40 courses in 53 cities throughout the U.S. and six cities in Canada. During 1991, over 2,000 classes were taught for more than 20,000 students. The company also develops computer-based training (CBT) courseware. Instead of following the old cliche, **if you can't do it, you teach**, IBI follows the concept that, **if you can't do it, you can't teach it**. Their instructors are required to have practical background and in-depth understanding (Slagowitz 1992). The education industry can learn much from vendors.

One exception to the nondisclosure policies is **Andersen Consulting's** support of a text and software for business systems design instruction (Flatten 1992). Another exception is the **Institute for Academic Technology (IAT)**, referenced above. Others should be identified and recognized.

An example of the problems the present administration is facing are the squabbles over job training. It has been estimated that the government spends $25 billion for job-training. In spite of Secretary Reich's efforts to help reinvent the government's way of administering the job-training effort, it appears that he has encountered major problems (Del Valle 1994). A management problem seems to have been building over the years because of split responsibility for and the supervision of training.

For a summary of learning in America related directly to the workplace, most of which is in competition with the education industry, see The Learning Industry (Eurich 1990).

CONTRIBUTING ORGANIZATIONS

Within each industry making up the information society, there are many well-intentioned organizations, each in its own way contributing to improved support of the information society. It is time for the education industry to capitalize on this foundation and integrate the contributions of these resources for the benefit of all academic institutions, and the education industry as a whole.

Some organizations are umbrella groups, such as the **American Council of Learned Societies, Council of Scientific Societies,** and the **Council of Social Science Associations**. Some are trade groups like the **Information Industry Association (IIA)**, and the **Information Technology Association of America (ITAA)** founded as the Association of Data Processing Services (ADAPSO). Others support functional areas rather than organizations as a whole. For example, the **American Society for Information Science (ASIS)** is library oriented, as is the **American Library Association (ALA)**. The communications industry has the **Association of College & University Telecommunications Administrators (ACUTA)**, dedicated to the functional area indicated by the title. The computer industry has had the **Association for Computing Machinery (ACM)** nearly since the introduction of computers. The ACM has **SIGs (Special Interest Groups)** similar to those with ASIS. Both serve small groups with similar area interests. Another group contributing toward improved use of computers is the **Institute of Electrical and Electronics Engineers (IEEE)**. The **Modern Language Association** has an excellent track record for the application of

computers. The CUPLE (Comprehensive Unified Physics Learning Environment) project is sponsored by the American Association of Physics Teachers. Infomart in Dallas is an example of an organization providing a clearing house for information technology. However, the education industry is conspicuous by its absence at Infomart. Other disciplinary societies and organizations include: American Assembly of Collegiate Schools of Business (AACSB), Association of Collegiate Schools of Business and Programs (ACSBP), American Economic Association, American Chemical Society, American Council of Teachers of Foreign Languages, American Institute of Physics Society, American Philosophical Association, American Political Science Association, American Association for Public Administration, American Psychological Association, American Psychology Society, American Sociological Association, American Society of Engineering Educators, Center for Applied Linguistics, Linguistic Society of America, Mathematics Association of America, Psychonomics Society, and the Society for Computers in Psychology.

With little doubt, the Carnegie Foundation for the Advancement of Teaching is the most recognized educational organization. Others are the National Education Association and the American Federation of Teachers. Within the education industry, the number of organizations is overwhelming. Each and every functional area or faction thereof has a dedicated organization. Some of the organizations are restricted to membership by schools or colleges. For example, ACUTA accepts no individual members. Both EDUCOM and CAUSE are made up of member colleges and universities, with individual membership sponsored by the schools. These are unique organizations in that CAUSE, originally, had primary interest in administrative computing functions, while EDUCOM focused more on academic computing applications. Now both are expanding their roles in support of information technology. For example, there were 10 winners in the seventh annual 1993 EDUCOM Higher Education Software and Curriculum Innovation Awards recognition ceremony. In some cases, EDUCOM and CAUSE have joined other organizations to undertake joint efforts.

The American Association for Higher Education (AAHE) is a "citizen's organization" where faculty, administrators, and students from all sectors, plus policymakers and leaders from foundations, government, and business, can address collectively the challenges higher education faces. The community colleges have two well-recognized organizations. One is the American Association for Community and Junior Colleges. The other is the League for Innovation in the Community College. Other groups are the National Association of State Universities and Land-Grant Colleges, and the Council of Higher Education Management Associations (CHEMA).

More specific functional area organizations are the Internet Society, the Online Library Computer Center (OCLC), the Association of Records Managers and Administrators (ARMA),

Software Publishers Association, the Data Administration Management Association International (DAMA), the Society for Information Systems (SIM), the Information Resource Management Association (IRMA), Data Processing Management Association (DPMA), the College and University Computer Users Conference (CUMREC), the National Association of College and University Business Officers (NACUBO), the American Association of Collegiate Registrars and Admissions Officers, the National Association of College Stores, Inc., and the Student Information Systems Users (SISU) group. The National University Continuing Education Association has encouraged the rise in life-long learning enrollment. A trade organization for vendors is the Association for Information Media and Equipment. There are many other organizations contributing in their own way.

Coordination of Effort

There is a lack of coordination, integration of efforts, and need for elimination of duplication of effort. As an attendee at the CAUSE'93 Conference asked, "How many organizations must we belong to in order to obtain the answers we need?"

Some of the organizations publish the proceedings of their annual conferences. Others do not, apparently on the assumption that without published conference proceedings, individuals will be obligated to attend. The opening day at a number of annual organizational meetings is devoted to scheduling preconference special presentations. These appear to be the most prestigious because an extra charge is made from $115 to $280 per session. When about twenty sessions are stripped out of a two- to three-day conference program, the heart of the conference is often lost to those schools not able to afford the extra cost. A possible solution worth consideration is for the top twenty presentations for each annual conference to be identified and the authors/presenters to be recognized and reimbursed for their efforts. This would eliminate skimming the cream off the conference and make the presentations available to all attendees without an extra charge.

Examples of Coordination Efforts

There are several examples of coordination of efforts by organizations that support education. One example began three years ago when CAUSE, EDUCOM, and the Association for Research Libraries formed the Coalition for Networked Information (CNI). According to Julia Rudy, the three parent organizations renewed their commitment to continuing the work of CNI. The activities of the CNI group is now being reported by the chair of the Steering Committee, Richard West, in the CAUSE/EFFECT publication (Rudy 1993).

Another example is an association called CHEMA, the acronym for the Council of Higher Education Management Association. The CHEMA group is composed of twenty-seven member organizations; many are listed in the previous discussion of contributing organizations. Out of this group, fourteen members, under the leadership of CAUSE, developed a report called Contract Management or Self-Operation: A Decision-Making Guide for Higher

Education (CHEMA 1993). As Jane Ryland said, "Contract management, privatization--in the information technology environment we're more likely to call it **outsourcing**, but all the terms have essentially the same meaning--entrusting to external organizations the operation of traditional campus functions or services," (Ryland 1993). Unfortunately, the study appears to have omitted a major consideration for outsourcing: the need for the staff, faculty, and students to participate in the design, development, operation, and maintenance of computer-supported applications. This participation is a valuable educational experience as well as a beneficial one for the campus as a whole. If these applications are outsourced to vendors or consulting firms, the academic institutions will no longer have the opportunity to work with the development and maintenance of their own systems and applications in an educational environment. The learning opportunities will be lost. Outsourcing to other educational institutions does hold the promise of reducing costs and creating savings for many organizations.

Outsourcing

The education industry can benefit from the U.S. Air Force method of management in their human relations support system. For example, the human resources support for the SWSC military personnel located at Peterson AFB, CO, resides at the Air Force Military Personnel Center, Randolph AFB, TX. Copies of the personnel records are available in a local personnel office; however, all payroll functions are performed by the Defense Finance and Accounting Services Command, Denver, CO.

A similar human resources facility could be operational for Kansas college students at state-supported institutions in the state of Kansas. For example, any one of the state universities could manage the human resources support system for all state employees working for state colleges and universities. A similar system could support a multi-school student information support system for all other state-supported schools within the state. A similar student information system support center could be established for all other institutions within the state on an outsourcing basis or as a computing utility. State boundaries should not prevent the state-supported student information system in Kansas from supporting schools in other states. For instance, the U. S. Air Force Military Personnel Center knows neither state nor command boundaries. Lessons can be learned from the military and applied to the education industry.

EVALUATION

There are numerous examples of evaluations of many different types of organizations. For this discussion, the fine line between **appraisal** and **evaluation** is omitted. Within the business world the most prestigious award has been the **Malcolm Baldridge National Quality Award**. This award is given annually by the Department of Commerce to a handful of businesses that demonstrate themselves to be of world-class quality. It is anticipated that the award will be opened to educational and health-care institutions in 1995 or 1996 (Fuchsberg 1993). Within

the information industry, the **American Library Association** has an extensive evaluation system for libraries. Several groups attempt to evaluate and rate colleges and universities. **U.S. News and World Report** publishes the results of an annual survey of "America's Best Colleges" and "Best Graduate Schools." Fortune Magazine holds summits of executives, politicians, and educators to aid education. According to The Chronicle of Higher Education, "States' Practice of Grading Public Colleges' Performance Gets an F From Critics," (Mercer 1993). From an information technology point of view, ComputerWorld publishes its Premier 100 annually. The **Society for Information Management (SIM)** has its annual Partners in Leadership Award Competition. BusinessWeek has been publishing a listing of "The Best B-Schools" since 1988.

Within the college and university portion of the education industry, the **National Association of College and University Business Offices (NACUBO)** has a form of evaluation and presents annual awards to those schools with outstanding cost reduction programs. The **Coalition for Networked Information (CNI)**, referenced previously, recognizes the need for improved evaluations by forming a working group on Management and Professional Development updating the **CAUSE/EDUCOM Evaluation Guidelines for Institutional Information Technology Resources**. These guidelines were originally published in 1988. **CAUSE** made its first presentation of the **Award for Excellence in Campus Networking** during the CAUSE'93 convention. This award recognized exemplary campus-wide network planning, management, and accessibility, as well as effective use of the network.

The term **benchmarking** in this discussion is the act of contrasting how functions are carried out in one organization with others. The other meaning for benchmarking is a measurement for testing the performance of computers using a benchmark program. **NACUBO** has a two-year trial benchmarking project with 120 institutions (Blumenstyk 1993). This has been an accepted business practice for years. One of the author's early experiences in this area was with **HABACUS**, the Health and Beauty Aids Computer Users Society during the early 1970s. There are many others. Colleges and universities can learn much from how the business world encourages assistance among its members. In addition to the evaluation efforts underway, much can be accomplished through expanded cooperative evaluation efforts conducted on campuses.

STUDENT HONOR SYSTEM

Sixty years ago when I was a cadet at Kemper Military School each member of the cadet corps signed an honor code. The code was administered by the cadets with minimal faculty guidance. It did make an observer of an infraction of a rule responsible to make a report of the observation. If the cadet did not make a report of the infraction, he was as responsible as the cadet who was in the wrong in the first place. It seems to be that many school honor codes fail to prevent the widespread distaste for accusing one's classmates. This factor appeared to be the key failure during the recent United States Naval Academy infamous engineering exam

where midshipmen refused to turn in known cheaters. This example is indicative of the failure on the part of citizens as well as students who refuse to become involved when they know who is guilty of breaking the law.

The author realizes that the concept of an honor system is not universally accepted. There are a number of individuals who question the concept in its entirety. For an excellent discussion of some of these positions, see the chapter by **Donald L. McCabe** and **Linda Klebe Trevino** on **Academic Dishonesty** in The Journal of Higher Education (McCabe and Trevino 1993).

When this country adopts a strict honor code for all students at every level, the knowledge society, in the following chapter, will have a stronger foundation. The concept of the NII is to provide a broad range of economic and social goals for the United States. Having an honor system accepted throughout will provide a major benefit.

AUDIT, ETHICS, PRIVACY, AND SECURITY

There should be increased instruction at all levels in education for the subjects of **audit, ethics, privacy,** and **security.** Entire campuses will benefit from more discussion and understanding of these subjects. This is particularly true of information technology tools and methods where a greater premium is placed on the concepts of audit, ethics, privacy, and security. However, these subjects will benefit all individuals on campuses.

Students need an appreciation of the disadvantages from the early attempts to **audit** around the computer rather than taking advantage of the computer's resources to assist in audits through or with the computer. There is also a need to understand the difference between audit and evaluation. An audit determines whether or not the computer application operates within the design specifications for the system. An evaluation determines whether or not the application meets the needs of the users.

There is a vast number of organizations developing **codes of ethics.** For example, **Effy Oz** points out that several professional societies are shaping ethics codes for information systems professionals. She identifies five efforts and shows how some are overlapping, even confusing, and points out the need for a unified code of ethics (Oz 1992). The most outstanding effort in the area of ethics is the work of a subgroup of EUIT led by **Frank Connolly** and **Sally Webster.** The effort was sponsored by **EDUCOM's EUIT (Educational Uses of Information Technology)** group. The results of the effort culminated in the **EDUCOM ETHICS KIT,** published in 1993 by PRIMIS McGraw-Hill (ETHICS KIT 1993).

There is still some question about teaching **ethics.** For example, prior to 1988 it was possible to obtain an MBA at Harvard without any explicit instruction in ethics. Since that time, Harvard is reported to have added the study of ethics in a number of ways, including nongraded sessions, case studies, and ethics electives. Others, such as the University of Virginia's business school, treats ethics like any other subject, a full-semester graded course (Byrne 1992). A required student honor

system, referenced above, will give the students an introductory foundation for further study of ethics.

Encrypted data introduces a subject of concern to all citizens. Unfortunately, very few citizens have knowledge of why they should be concerned. Student awareness of the **Data Encryption Standard (DES)** will introduce them to an enjoyable history of encryption. A book entitled The Codebreakers is a recommended reference (Kahn 1968). The problem is whether or not the DES approved by the Bureau of Standards in 1977 should be banned and replaced by a federal standard that only government-approved agencies could control. This subject should create further interest in the problems connected with finding a balance of computer software, intellectual property, and the challenge of technological change. A government agency having primary concern with this problem is **the Office of Technology Assessment**. The **House Committee on the Judiciary** has primary responsibility within Congress (Gibbons 1992).

Earlier this year (1994) it was reported that the Clinton administration would promote but not mandate the use of a controversial encryption technology. This has failed to mollify users, vendors, and civil libertarians, according to the conclusion of **Gary Anthes**, Some of the arguments, according to Anthes, are that it will prove unnecessarily costly, harm U.S. competitiveness and contribute little to national security (Anthes 1994). It appears that students will be involved in the subject of encryption for a long time. For a balanced picture of the **Clipper chip cryptography standard**, see the discussions in the 25 July 94 Computerworld (Denning and Weitzner 1994).

Under the heading of **Intruders, Worms, and Viruses** the subject matter is of concern to all, and to students in particular because of their abilities and lack of understanding. For further understanding of the vulnerability of computer systems to harmful, if not catastrophic attacks, see **Peter Denning's** book Computers Under Attack (Denning 1990).

Privacy in the education industry has been a topic for discussion for many years; understandably, the discussions have become more intense since the **Buckley Amendment**. This amendment was to the **Omnibus Education Act**, passed in 1974. To paraphrase **Robert Curran**, he points out that the problem with privacy and computers is not the technology, but the lack of value education in the people who use, teach, and learn about computers (Curran 1989). Father Curran's statement seems to be justification enough for students to learn more about privacy. This is very true when topics such as **Caller-ID** (calling party identification) is the subject of discussion.

LIFE-LONG LEARNING

Correspondence courses, the original examples of **distance learning**, have been in use for over a century. These correspondence courses are also examples of **life-long learning**. Many taking the courses have been out of school for some time. One definition of distance learning is the delivery of instruction from a central site to one or more remote locations.

Schools are providing two-way communications links between students and teachers, and among students. Instruction can be in a classroom and broadcast live, making use of TV channels, satellites, or networks that let students and instructor communicate, sometimes delayed and in other instances in real time. The **Arts and Sciences Teleconferencing Service (ASTS)**, headquartered at Oklahoma State University in Stillwater, is one of the country's leading suppliers of satellite-delivered instructional programming. More than 6,000 students at 525 rural high schools have access to ASTS courses such as German, physics, and trigonometry, taught by Oklahoma State professors (Jordahl 1991).

Some courses are prerecorded video, called **telecourses**. For example, those offered through the Annenberg Corporation for Public Broadcasting Project, are reported to be in use in 2,000 U.S. colleges. Another example is that of 4,000 corporate engineers who earned advanced degrees at their workplace via satellite from the **National Technological University**. This university is now one of the largest engineering schools in the nation, based in Fort Collins, CO. Faculty are drawn from 40 universities, including the Georgia Institute of Technology, Purdue University, and the University of California at Berkeley. This provides an interchange of faculty, and a sharing of scarce resources. No one formally tabulates distance learning at the college level; however, it is estimated that these part-time students account for approximately half of all college enrollments (Graham 1991a).

Eighteen universities during the fall of 1991 began offering students, in more than 14 million households around the country, an opportunity to pursue a baccalaureate degree. These courses are delivered entirely by cable television and satellite. A previous reference was made to **Mind Extension University (ME/U)** and its use of satellite transmission. This organization is devoted exclusively to education. Students have access to an 800 telephone number and can leave messages for their professors in an electronic mailbox (Watkins 1991a). For the 1993 school year, there were twenty-one of the leading distance education universities across the nation participating. For example, **Regis University** supports a Bachelor of Science in Business Administration Degree Completion Program; **Colorado State University** provides a Master of Business Administration. These are but two of the many programs available (ME/U 1993).

The **National Distance Learning Center (NDLC)** operates an on-line, interactive, data base service providing information on over 4,000 courses, teleconferences, curriculum development, and supplementary materials available to teachers and students nationwide. The NDLC brings information about educational resources available at a distance. Operating out of Owensboro, KY, the NDLC is in partnership with the U.S. federal government as a public service dedicated to providing immediate electronic information exchange. The database is maintained as a virtually free resource that is accessible to anyone with a computer and a

modem. For example, the subject of information management is available from **ISIM** the **International School of Information Management**, Santa Barbara, CA (Polson 1992).

The University of Maine at Augusta worked with the **New England Telephone Company** in implementing a network linking seven campuses. The U.S. Department of Education provided a $3.5-million grant making the networking possible. The total cost of the system was approximately $7.5-million. According to President **George Connick**, there are over sixty-five courses offered at more than eighty sites, with average class size of nearly 120 students. Participating faculty are recognized and rewarded both financially and for credit-hour production (Connick 1993).

Thomas Edison State College in Trenton, New Jersey, released a new version of its **CALL (Computer-Assisted Lifelong Learning) Network** and claims it to be the most complete higher education system in the world for adults. CALL is a 24-hour system available to all students for many college services (CALL 1994).

The University of Phoenix is a little-known, controversial and booming business school that claims to be the nation's twelfth-largest private university having granted over 60,000 degrees. Operating as an on-line institution, in a for-profit environment, it has been quite successful (Stecklow 1994).

A leading consultant in this area, **Suzanne Douglas**, points out that today's technologies are not always utilized in the best possible way. From her observations, she cautions that no single technology can do everything, and even a mix of technologies must be carefully tailored to address specific goals (Douglas 1993).

Senior Citizens

One of the greatest losses within our society is the loss of the experiences and knowledge of our senior citizens. Aging is increasing within the U.S. population; unfortunately, there is insufficient incentive for senior citizens to continue with their life-long learning. Of equal importance is that there is no encouragement for senior citizens to contribute toward cultivating knowledge development. In spite of the fact that creativity is most often found in much younger individuals, many senior citizens have guarded creative concepts of their youth because they have never found an outlet. Some of these creative ideas may still be worthy of development. At least, many are worthy of evaluation.

In the Introduction, the concept was described as being designed to prepare the public for the implementation of the NII through the education of individuals. Students of all ages are included with coverage extended to adults taking advantage of life-long learning. An attendee at **CAUSE'93** described the group as **K-90**. However, in my retirement home, the age should go beyond 90 as our senior citizen is nearly a hundred, and the lady who conducts the Friday night discussion group is 93, a retired school principal. She gave herself a balloon ride as a present for her 93rd birthday. For her 94th birthday she is considering a try at scuba diving!

NATIONAL INFORMATION INFRASTRUCTURE AGENDA

The National Information Infrastructure agenda includes a major statement about life-long learning.

> Increasingly, what we earn depends on what we learn. Americans must be well-educated and well-trained if we are able to compete internationally and enjoy a healthy democracy. The magnitude of the challenge we face is well-known:
> 25 percent of students nation-wide no longer complete high-school, a figure which rises to 57 percent in some large cities.
> Concurrently, 90 million adults in the United States do not have the literacy skills they need to function in our increasingly complex society.
> The Clinton Administration has set ambitious national goals for lifelong learning. The 'Goals 2000: Educate America Act' would make six education goals part of national policy: 90 percent high school graduation rate; U.S. dominance in math and science; total adult literacy; safe and drug-free schools; increased competency in challenging subjects; and having every child enter school 'ready to learn.' Secretary of Labor Robert Reich also emphasized the need to move towards 'new work.' New work requires problem-solving as opposed to rote repetition, upgrading worker skills, and empowering front-line workers to continuously improve products and services. All of the Administration's policy initiatives (national skill standards, school-to-work transition, training for displaced workers) are aimed at promoting the transition towards high-wage, higher-value 'new work' (NII 1993).

FUNDING

The main reason given for nonconcurring in most any recommendation for improving the education industry is funding. It must be realized that for the years 1991, 1992, and 1993 Congress earmarked a total of **$1.94 billion** directing agencies to provide for projects involving specific colleges and universities (Cordes and McCarron 1993). Another **$2.4 billion** is estimated to have been given by U.S. companies in 1992 to universities, colleges, and schools (Micklin 1993). An Associated Press article pointed out that corporate sponsorship of university research had nearly doubled between 1988 and 1991 (Castello 1993).

The U.S. Department of Education was not established until 1979. Since then the department has grown into a major government agency. The spending bill for 1994 contained **$28.7-billion** for the Department of Education. This was a 2.4 percent increase over the previous appropriation (Zook 1993). It is most unfortunate that these expenditures have resulted in an observation from Business Week that schooling has not improved since the Education Department was established in 1979, and it would not be missed (Gleckman 1993). Figures from the Department of Education for

school year 1994-95 show a total of $397.3 billion in expenditures for public elementary, secondary, and higher education. Private schools and colleges will spend about $96 billion (Henry 1993). Under the President's budget plan for fiscal 1995, budget support for research and development at universities would go up 3.7 percent (Burd et al. 1994). States will spend $42.8 billion on public colleges and student-aid programs in 1994-95, an increase of 7.6 percent over 1992-93 (Lively 1994). According to Diane Ravitch, we need a stable, long-range program of research and development to guide the investment of hundreds of billions of dollars each year in education (Ravitch 1993).

It would be interesting to know what happened to the $365 million Walter Annenberg's Foundation gave to colleges and universities and what will happen to the $500 million he announced on 17 December 1993 to be given for use in education over the next five years. The intent is not to find out what grants were made or projects funded, but the results from the expenditure of $865 million in total. The education industry could gain a lot if it placed more emphasis on the results, rather than on who obtained the grants and for how much. Many faculty are hired because of their track record for obtaining grants without consideration for what they contributed from their efforts.

COLLEGES AND UNIVERSITIES

Student Ownership of Computers

Dartmouth College continues to be recognized for pioneering the requirement for students to own computers. A few others have a similar requirement. Ownership is also required for students in programs like computer science, engineering, and some MBA programs. More and more colleges are charging computer fees to all students, provoking protests on several campuses (Dube 1993). The Tenth Annual Survey of Business School Computer Usage reports that 87 percent of the undergraduate programs do not require student ownership of microcomputers at this time. For the remaining schools, eight percent said they were recommended, two percent were planning to require ownership, and one percent had requirements for finance and accounting majors, (Frand, Britt, and Ng 1993,12-13). An example of students acquiring portable computers is at Hartwick College, Oneonta, NY, where freshmen are paying an additional $650 a year in tuition to cover the cost of a computer, printer, and software that each receives (DeLoughry 1993b).

Some schools have been pressured into giving up the student ownership concept because the costs are excessive for student budgets. Not long ago calculators presented the same cost concern as computers. Calculators initially cost between $700 and $800. These prices were excessive; however, due to mass marketing, prices went down to the point that students, even high school students can afford a calculator. A similar case has been made using the cost of a slide rule 25 years ago (Heterick 1993,2).

The education industry should encourage competition in the manufacture of **personal digital assistants** (PDAs) that can make use of the installed TV base in the U.S. In discussing **Mike Zastrocky's** comments on an earlier edition of this paper, he pointed out that according to the U.S. Census there are more TVs in American households than indoor plumbing (Zastrocky 1994). The need is really for the students to have a workable, portable interface with the Internet that will permit access to the World Wide Web or a similar resource. These PDAs will become **home computers** in family rooms, available for use by all in the NII environment. By providing the PDAs with terminal capabilities, the students can use their own machines as substitutes for most of the computer laboratory computers. By shifting the budget requirements for many microcomputers to students, schools can save a noticeable amount of money. These savings will more than offset the research and development funding.

The mass marketing potential amounts to between 14 and 15 million sales for college students alone. With open competition, vendors can see which can make the best PDA for the best price with appropriate software and maintenance included. High school students, parents, even grandparents, are additional mass marketing potentials.

Textbooks

Bernard Gifford, in Business Week, has observed that tomorrow's textbooks will be more like study guides. He suggests, personal academic notebooks that accompany computer-mediated learning systems. He invisions inclusion of organizational guides through courseware, methods for evaluating progress, and homework problems and exercises for small groups (Gifford 1993).

Before all college courses can reach this level, the classrooms need upgrading with appropriate multimedia resources to make the presentations possible. In fact, neither are most classrooms equipped with **telephones**. Due to this classroom multimedia equipment shortage, it will be necessary for the course materials to be published in typical hard-copy textbook format, initially, as well as in multimedia. One textbook format is a disc for use with **Xerox DocuTech Production** equipment to manufacture the number of copies required for their students on each campus having the equipment. Over 50 colleges and universities have this equipment available with others now being added. For example, it is reported that the **Cornell Campus Store** publishes custom and current course packets. The **Xerox Magneto/Optical** storage disks permit both read and write capabilities with a high degree of compaction. Xerox calls this capability **documents on demand**.

Because of the differences in requirements within the many disciplines, the knowledge development course materials are also ideally suited for **custom textbook publishing**. These custom publishing systems let the instructors select the subject matter to be included in the texts and for use in the classroom. Where the college or university has an on-campus system for producing copies of texts for classroom use, distribution of the material

can be made electronically from the publisher to the campus.

The electronic distribution of the material can be downloaded even further, to each student's personal computer. This is now technically feasible. The Internet is a major resource for making this downloading possible. Using the Internet would be an adaptation of its use for the electronic transmission of journals by **TULIP (The University Licensing Program)** (Wilson 1992a). The texts could be distributed through **CUPID (Consortium for University Printing and Information Distribution)**, a subcommittee of the **Coalition for Networked Information**. Another resource is through **PRIMIS**, McGraw-Hill's custom system as operated by the University of California's San Diego campus electronic publishing center (Watkins 1991b). No doubt there are other resources worthy of consideration, but not included.

Integrating Instruction

There is a lack of **integration** of subject matter. There is also an amount of **duplication** above and beyond the need for reinforcement. For example, spreadsheet software is often included in a number of subjects with no one actually coordinating the content from the students' standpoint. As a result, the students are subjected to bits and pieces of the tool subject matter, rather than learning through actual on-campus applications. The other extreme is where a course is dedicated to the tool subject and more is included than the student will ever need to know about the tool.

There have been many attempts at team teaching in colleges and universities; however, few have attempted to expand the concept like **Drexel University** to adopt the approach university-wide. This effort was initiated with a grant from the **National Science Foundation (NSF)** of $2.3 million in 1988 to develop the model curriculum in the engineering college (Collison 1993). The knowledge development courses recommended in the following chapter can profit much from the experiences at Drexel in interdisciplinary instruction. After many years of competition, the information technology disciplines of computer science, electrical engineering, and management information systems, are integrating elements of their existing disciplines that deal with information. According to a National Science Foundation Task Force report, Educating the Next Generation of Information Specialists, a new discipline was recommended for information generation and usage referred to as **Informatics**. The discipline includes a detailed four-year undergraduate curriculum in Informatics (Mulder 1994). Unfortunately, the task force appears to have overlooked the accomplishments of the **American Medical Informatics Association** with headquarters in Bethesda, MD. Specifically, for one example, the implementation of a Medical Informatics program at the Kansas University School of Medicine in 1990 and 1991 (Parks, Minns, and Manning 1992).

The **New School of Information Management and Systems** at the University of California, Berkeley is the result of a collaborative effort by representatives from Berkeley's business school, law school, engineering college (including computer

science), public policy, journalism, and the University's library and information systems and technology organizations (Rudy 1994).

Changing Academic Product Mix

Senior college administrators have not taken the time to study their customers, the undergraduate students and the organizations who hire their graduates. This lack may be caused by being inundated with biased facts from other administrators and faculty groups. Administrators want to protect their jobs. Faculty want to perpetuate the way they are teaching and reaping monetary benefits from gimmicks outside the classroom for personal profit rather than university profit. Some faculty are earning salaries from training classes equal to or greater than their teaching salaries. In case of argument, ask the individual to show you his or her tax returns. Neither administrators nor faculties want the presidents or chancellors to eliminate duplication of programs, unnecessary courses, or money-making opportunities.

The student bodies of the 1990s are quite different from those previously. Administrators and faculties seem to refuse to appreciate this fact. Of course, there are exceptions where tradition plays the dominant hand. However, as **Arthur Levine** observes, a growing number of students are seeking a stripped-down version of college. This means, without student affairs, extracurricular activities, residence life, varsity sports, campus chaplains, Greek life, the proliferation of specialty courses faculty like to teach, the research apparatus, museums, the panoply of auxiliary enterprises, and the expansive physical plant that constitute a college today (Levine 1993). As a result, four year colleges are losing enrollment to community colleges and the leaders fail to understand the problem (Wright 1993).

Changing Instructional Methodology

There appears to be a consensus within the literature that there is little reason to expect that changes can be made in classroom methodology because of the agreement that it is the domain of the faculty. By 1989, there were many examples of successful investments in technology (Graves 1989). Unfortunately, the use of IT in the classroom has not met expectations because of the reluctance of the majority of faculties to participate, and the cost of multimedia capabilities in the classrooms. As a result, other methods are needed to bring about the changes in instructional methodology.

Students have shown on many campuses that they can encourage the faculty to begin using E-mail and voice-mail. Students can also bring pressure on the faculty to use more multimedia and other IT advances. As the improved instructional techniques in areas like chemistry, mathematics, music, physics, and foreign language become better recognized, faculties need to be directed to participate. The education industry must recognize these developments and encourage their use in the classroom. Another area of encouragement is needed in life-long learning.

COMMUNITY COLLEGES

The community colleges, with nearly half the college enrollment in the U.S.A., are the most progressive in meeting the needs of the communities in which they are located. The education industry can learn much from the **Maricopa Community Colleges**, the **Miami-Dade Community College**, and **Thomas Nelson Community College**. For an excellent summary of the developments in the use of information technology in the two-year institutions (technical, junior, and community colleges), see Transforming Teaching with Technology: Perspectives from Two-Year Colleges (Anandam 1989).

In spite of the competition from commercial training by vendors and consultants, community colleges are being recognized for their efforts in supporting the needs of local industries and agencies. This support includes providing specialized instruction for retooling the workers. Because many schools face shrinking state funds, these sponsored programs generate much needed income (Therrien 1993).

Other colleges and universities can learn much from the community colleges as they operate today in support of their communities. Instead of trying to compete with the community colleges, the four-year schools should make better attempts to incorporate their contributions into the mainstream of college education. Cooperative efforts have been accomplished in a number of locations, and should be recognized and imitated.

Although some community colleges have attained recognition for their campus networks and support of computers, many have not reached this desired level of accomplishment. As a result, many community colleges are isolated in their existence, unable to make use of external networks such as the Internet.

While attending an Association for Computing Machinery conference in Phoenix, Arizona during March 1994, I had the opportunity to interview **Ronald D. Bleed**, Vice Chancellor for Information Technologies, Maricopa Community Colleges. The education industry can learn much from the type of instruction being conducted on the ten campuses making up this institution. The administrators and faculty listen to the needs of their customers. These customers include not only the students, but the organizations that hire their students or already have employees who are also students. The emphasis is on the direct relationship between what is presented in the classroom and what the students need to learn to apply the knowledge on their jobs (Bleed 1994).

The Maricopa experience is a very basic form of knowledge development. Unfortunately, the education industry should have demanded this level of involvement by 1990. Now it is time to recognize that major emphasis needs to be placed on the students' ability to develop foresight and leadership in each area of interest. By developing foresight, students and teachers will be able to identify areas of need, and through leadership, guide the implementation of the products or solutions to meet the needs identified. The EIS application as an operational system instead of an automated briefing book is illustrative of the intent of

the redirection of our classroom effort.

K-12 RESPONSIBILITY

Colleges cannot be expected to do it all. An introduction to information technology tools is taking place in grades K-12. Keyboarding begins in kindergarten. Early examples were Apple computers, IBM's Writing to Read, and the Macintosh. Since those early days, a short time ago, there has been a new generation of **edutainment** software increasing sales of home-computers and school classrooms. The interactivity of these newer programs is intended to turn classroom computers into high-tech learning tools, replacing the **drill-and-practice** computer instruction. Two leading vendors are **Jostens Learning Corporation** and **Computer Curriculum Corporation** (Armstrong, Yang, and Cuneo 1994). It is too early for firm evaluation, also for the 140 **charter schools** operating in eleven states (Wallis 1994). The **Edison Project** is an example of a concept under review. Another area of concern is that of **parents teaching children at home**. It is estimated that since the late 1970s, when 12,500 children were taught at home, the number may be as high as half a million (Gibbs,N. 1994).

Twenty-two percent of the undergraduate business school programs and twenty-eight percent of the MBA programs have computer entrance requirements. This has been described as a **computer 'driver's license'** with proficiency in word processing, spreadsheets, and databases (Frand, Britt, and Ng 1993,iv). At present, the edutainment concepts seem to be supported more by marketing money than by scholastic evaluation.

Tool Subjects

Some tool subjects are too specialized for all students prior to college. Exceptions are courses taught in technical high schools such as CAD/CAM (computer assisted design/computer assisted manufacturing), decision support systems, desktop publishing, expert systems, graphics, simulation, and statistics. What may appear to be too specialized today will be included in general information technology instruction tomorrow. As the foundation in the K-12 level expands, the students can absorb greater depth of understanding. For example, students exposed to CAD/CAM will progress faster in engineering schools when exposed to the use of **stereolithographic apparatus (SLA)** technology. This is a form of desktop manufacturing where a computer-assisted design item is transformed directly into a physical part without aid of a machine/tool shop (Meadors 1992; Chaudhry 1992). This relates to the previous reference to Ted Lewis's comments on visualization and 3D developments.

Another subject not commonly included in high school courses is artificial intelligence (AI). A previous reference to AI was in the discussion of expert systems. However, one example shows that the subject is being included. **Richard W. Dillon** teaches artificial intelligence, robotics, and relational databases at the Classical Greek Magnet High School in Kansas City, MO. This gives students an understanding of the application of **fuzzy logic** in camera circuits used to control automatic focusing (Dillon 1993). The need for these subjects is yet to be determined.

Year-Round Education

Many K-12 school administrators, teachers, and others will claim insufficient time for computer-supported instruction. A solution is for schools for grades K-12 to operate 12 months a year. The Perry McClure High School in Buena Vista, VA has been open throughout the year since 1973. The concept's introduction in Virginia encouraged the formation of the **National Association for Year-Round Education**. This organization identifies 2,048 schools open year-round in twenty-six states (Bradford 1993). Year-round does not mean without vacation periods. The school day should be extended until five o'clock in the afternoon to provide a safe place for students to do their homework or use computer networks. This would eliminate much of the "latch-key" problem.

Within the literature there are many solutions to homework; however, few recommend increases in the homework being performed at school with a reduction of that required at home. Without question there are benefits to doing homework, as pointed out by **Gabriella Stern**, such as self-discipline, time organization skills, and independent problem solving. She also found that less homework is actually being assigned and accomplished. In a recent article entitled "Kid's Homework May Be Going the Way of the Dinosaur," the title seems to summarize the situation as she sees it (Stern 1993). In grades K-12 a detailed study may find that much of the homework could become **school work**. If the schools are open, students could do much of their **homework** at school with the supervision and assistance of teachers rather than parents. Supervising study halls should still be a part of teaching.

This extended school period can be used also for **GANG BUSTER** student organizations to provide an environment for students to participate in character-building activities, similar to the Scouts and Future Farmers of America. The K-12 students seem to be crying out for leadership and discipline. Students need an opportunity to become a part of a group that is recognized. By recognizing the need, like driver education, time will be found. If the schools are open and provide an atmosphere for creativity, service, and encouragement, the students will come.

Schools the Centers of Communities

Elementary schools, high schools, and community colleges should become the focal point for community activity. For example, the **Colvin** and **Stanley Elementary Schools** in Wichita, KS are schools fulfilling the requirement as centers of their respective communities (Crumbo 1991). The **Blacksburg, VA Electronic Village** experiment more firmly incorporates the community center with the public, students, and local university working together and tied together by an electronic network (Heterick 1993,3). Another example is the **"Think Tank"** partnership within the City of Phoenix, AZ, joining elementary schools, high schools, the community college system, and business and industry (Bleed 1993). There are numerous examples of colleges and universities working with their communities. However, there seems to be a need for a national effort to recognize and encourage these efforts.

Busing Students

My neighbor and attorney friend, **Ted Sharp**, educated me in the excessive expenditures of cross busing school children. Ted has been volunteering his time attempting to educate the local school board, but so far to no avail. Ted's comments follow:

> Cross busing school children to achieve desegregation, is an educational concept whose time has come and **gone!**
> The 1960's U.S. Supreme Court case upholding cross busing was Swann v. Charlotte-Mecklenburg Bd. of Education 91.S.Ct.1267. This precedent created a rash of lawsuits in the Federal District Courts around the country, and an untold number of appeals to the various Circuit Courts of Appeal, and on to the Supreme Court.
> After some 25 years of cross busing in schools across the country the Supreme Court has now said in a March 1992 decision titled Freeman v. Pitts 112 S.Ct. 1430, that enough is enough. This case involved the DeKalb County School system in a major suburban area of Atlanta, GA with some 73,000 students in K-12.
> Some of the salient pronouncements by the court are quoted as follows:
> 'Racial balance in schools is not to be achieved for its own sake; it is to be pursued when racial imbalance has been caused by constitutional violation.'
> 'Once racial imbalance due to de jure violation has been remedied, school district is under no duty to remedy imbalance which is caused by demographic forces.'
> Demographic in this context meaning housing patterns.
> 'Where resegregation is a product, not of state action, but of private choices, it does not have constitutional implications.'
> Prior to the decision in the Atlanta case the U.S. Supreme Court in Board of Education of Oklahoma City v. Dowell 111 S. Ct. 630 (1991) said 'Desegregation decrees are not meant to operate in perpetuity.'
> The above statements of the Court's position leave no doubt that where a school district has fulfilled its obligation to desegregate, then it may resume its powers and duties free of Court supervision.
> **After achieving unitary status** the single biggest incentive to terminate cross busing is to save money that can be used for more pressing educational needs.
> The Wichita Kansas School District No. 259 currently spends some $10 million per year to transport school children. Much of this is by State mandate. The students with disabilities must be bused and any child living two and one-half miles or more from a school must also be transported at School Board expense. However, some 30 percent, or $3 million dollars is spent for cross busing to achieve desegregation.
> Ending cross busing would give the school district several desirable options as to placing the money saved. To

illustrate: In Wichita, the money could provide all teachers with an annual $1,100 salary increase, or provide 30,000 square feet of new construction per year, or buy each student some $63 worth of books, and classroom equipment each year.
Similar savings and alternative educational spending could certainly be found in any school district spending money on cross busing where it is no longer necessary.
School money should be spent for education not transportation (Sharp 1994).

Teacher Preparation

At the college and university level, knowledge of a subject area may well qualify an individual to teach the subject. Unfortunately, for grades K-12, knowledge of subject matter is not sufficient. For example, **Mary Hoy**, an education department dean, pointed out that teachers who fail do so because they can't function in the deplorable conditions impacting schools, and not because they don't know 'content.' The failures are due to an inability to solve the problems presented to them that have nothing to do with 'content,' i.e. pregnancy, suicide, drugs, hunger, and broken homes (Hoy 1991). Other items such as guns and knives should be added to her list.

There are numerous efforts underway to make improvements in teacher preparation and the way they teach. A single example is the effort by **AAHE's** project **"From Idea to Prototype: the Peer Review of Teaching"** (Edgerton 1994).

The public is demanding better teacher preparation. They are convinced that the methods being used are faulty. For example, David Awbrey asserts in an editorial in the leading newspaper in the largest city in Kansas what represents the feelings of many taxpayers. The recommendation was that the Kansas Board of Regents decree that teacher candidates earn degrees in liberal arts and sciences rather than education degrees. This relegates education courses to be taught on the side (Awbrey 1993).

SOFTWARE

The education industry needs to redirect the education of students for them to obtain sufficient knowledge of software design and development to eliminate the existing software crisis. The most visible example of this crisis is the delay in the opening of the Denver International Airport, caused by an inability to develop the necessary software to operate the automated baggage system. The software industry is comparable to the musket manufacturers who failed to be productive until they adopted Eli Whitney's concept of how to manufacture interchangeable parts (Gibbs 1994). An additional example is the FAA (Federal Avaiation Administration) and its inability to expedite the development of the improved air-traffic control system. If steps are not taken to change the way students who will work in software development are educated, software will be developed in Europe, India, Japan, Russia, or some place other than in the USA.

EDUCATION INDUSTRY HIGHLIGHTS

Educating students for world leadership in software design and development is but a segment of the need for them to deal with information naturally, as multimedia. As **Ramesh Jain**, the editor of the new IEEE MultiMedia magazine observed that interaction with computers should use all the senses used in interacting with other people. He wants computers to become natural (Jain 1994). This involves new directions in education about information, communications, and entertainment, as well as about computers. With increased effort and dedication the education industry can redirect the way education is conducted, and regain much of the loss of market share in education and training to vendors and consultants.

Improvements can be made in the way contributions are evaluated and implemented from the multitude of contributing organizations. The tremendous talent among the members of these organizations does not appear to be reaching its full capability. Through improved organization and operation, much of this talent can be applied directly to the education industry where it is needed. A major benefit can come from improved recognition of those schools and individuals where outstanding home-grown computer systems have been developed, but not available to other schools. This action will help increase the involvement of students and faculty members as well as functional area managers and end-users.

Instead of stressing information technology tools and skills, new approaches are needed by the education industry to integrate current IT advances into efforts for knowledge development. This shift is needed to provide for educating students in how to develop knowledge for each subject area and discipline.

The detractors who point out the lack of funding must be made to realize that better use can be made of those funds that are available.

6. THE KNOWLEDGE SOCIETY and THE NII

EARLY RECOGNITION

We are now entering the knowledge society. A previous discussion explained how the information society is supported by the information, communications, computer, education, and entertainment industries. The former reference to Time magazine's 1982 recognition of the **computer** as the **man of the year** is a milestone for a new era. At approximately the same time, Japan's **Fifth Generation Computer Project** was undertaken and later recognized as a blueprint for building a new **knowledge industry**. This was pointed out by **Feigenbaum** and **McCorduck** in the Prolog to their book The Fifth Generation. In addition, they recognized that in the knowledge industry, knowledge will be a salable commodity like food and oil. They wrote that knowledge itself is to become the new wealth of nations. They also pointed out that the computer is the knowledge worker's most important tool. They explained that knowledge is power, and that the computer is an amplifier of that power. In their opinion, a transition from information processing to knowledge processing was in order, from computers that calculate and store data to computers that reason and inform (Feigenbaum and McCorduck 1983).

Professor Feigenbaum stated a bit later in his Forward to the Mishkoff artificial intelligence book that, in his opinion, American response to the challenge of the Fifth Generation may determine our role in the post-industrial world, and that it is a world that revolves around a new technology with knowledge as its central feature (Mishkoff 1985). The same idea was expanded three years later in a book The Rise of the Expert Company (Feigenbaum, Nii, and McCorduck 1988). History will show that this book and other writings and lectures contributed toward the expansion of the efforts in the U.S. to prevent Japan from becoming the world leader in the computer industry as planned for their Fifth Generation project. This was only a battle, and the computer war is far from being over.

In 1983, several years prior to the TIPSTER undertaking referenced in Chapter 2, **Forest Woody Horton, Jr.** introduced his concept of a **Knowledge Gateway System (KGS)** for information access. Concurrently, considerable effort was made toward further development of the KGS concept at the Defense Systems Management College (Horton 1983). A year later, 1984, **Horton** described his concept for the KGS as another **knowledgeware** product. In his opinion, the user has been programmed to exploit the machine. In the future, he asserted that the process is to be reversed, to program the machine to exploit the potential of the mind. That is knowledgeware (Horton 1984). An even earlier reference is necessary because in 1971, **Milt Bryce**, the founder and president of M. Bryce and Associates, was telling his customers that his firm's slogan was **SOFTWARE FOR THE FINEST COMPUTER-THE MIND** (Bryce and Bryce 1988).

In **Peter Drucker's** opinion, knowledge acquired will need replacement every four or five years. Drucker feels that new technology will force greater changes in schools and universities

than have taken place in the past 300 years (Drucker 1992). The major objective of the knowledge development concept is to educate the masses in what they need to know to participate as members of the knowledge society and able to take full advantage of the NII as it develops.

While expanding my research for this revision of the earlier report, I found a reference to the need for knowledge development in a commencement address at the **Lubbock Christian University** in Texas. The address was given by **N. Lamar Reinsch** on 12 December 1992, entitled "The Mission of a University is to Create Knowledge." The text of the address is published in Vital Speeches (Reinsch 1992). The major points Reinsch developed were that knowledge is created in human conversations, and that education is a conversational experience. His third point was that a university would educate its community. This last point has been in the process of implementation for several years with the development of the **Blacksburg [Virginia] Electronic Village** (Holusha 1994).

Most faculty recognize that they are **knowledge developers**; unfortunately, many do not organize their classroom materials or course outlines to meet this objective. In **Russell Edgerton's** discussion of **Ernest Boyer's** January 1991 report of Scholarship Reconsidered: Priorities of the Professorate, he amplifies the responsibilities of faculty. These responsibilities are: "advancing knowledge, synthesizing and integrating knowledge, applying knowledge, and representing knowledge through teaching," (Edgerton 1993). These are also objectives of the knowledge development concept recommended in Chapter 7.

EDUCOM published a special issue of its Review on NATIONAL NETWORKING in the March/April 1994 edition. The most representative article that points out similar problems stated in the 27 December 1993 version of this report is **Bill Graves'** article "Toward a National Learning Infrastructure" (Graves 1994). In a more recent article, Vice President of EDUCOM, **Carol Twigg** states that, a better system of learning is needed to enable students to acquire knowledge (Twigg 1994). And **Drucker** observed, that in the knowledge society, people have to learn how to learn (Drucker 1993,201). There is much agreement on the need to not only change the definition of learning, but to provide an improved concept for developing knowledge.

Human nature is a problem that must be recognized in understanding knowledge development. Individual faculty members are human. By being human, there is a tendency to protect sources of information that become indispensable to persons who have attained positions as recognized scholars. These scholars are similar to the experts knowledge engineers work with in developing expert systems. Faculties are most reluctant to disclose the informational resources they use in their own knowledge development. As a result, the individuals who can contribute the most to the concept of knowledge development courses will probably be the most opposed to the concept.

In my own case, I was introduced to the applications of operations research and other quantitative techniques when on duty with the Weapons Systems Evaluation Group (WSEG) in the Office of the Secretary of Defense during the 1950s. Later, I introduced the first IBM 1401 computer for use under Army field conditions and developed a Combat Readiness [integrated] Exception Reporting system.

In 1964, when I entered college teaching, my attempts to integrate what I had learned about quantitative analysis and integrated exception reporting systems was overshadowed by the major controversy going on over whether or not business students should be taught FORTRAN or COBOL. Later attempts to integrate information resources management instruction met with similar resistance from my peers who demanded additional COBOL courses instead.

My first textbook Computers: A User's Introduction, in the 1970s opened with the following paragraph:

> One of the great achievements in the application of computers was the reliance placed on their use during the Apollo 13 mission. It was during this flight that a serious oxygen leak occurred which threatened the lives of the three astronauts. At that time they were about 180,000 miles away from the earth, well beyond the half-way mark to the moon. As a result, the command ship had to be evacuated and their intended moon-landing craft used as a "lifeboat" for a fast return to earth. This meant that the planned flight had to be redirected. To do so involved great risks and little margin for error. (Miller 1974).

It took years for NASA to recognize that Apollo 13 was a major success. Until a few years ago, NASA considered the flight to be a failure because the mission was not accomplished.

In 1983, I worked with Woody Horton on his Knowledge Gateway System concept as a consultant with the Defense Systems Management College. It was not until later, while teaching at the College of William & Mary, that I began formulating the knowledge development concept introduced in my previous report. I had invited two individuals from Alaska Airlines, based in Seattle, WA, to make an executive information systems (EIS) presentation to my Executive MBA class (Jamison 1988). During their discussion, it became apparent to me that what had been initiated as EIS for the use of top management became a day-to-day operating system for the entire airline. There are many advantages in all end-users having the same data and information in the same timeframe.

In 1993, I attended a briefing and observed the use of a flight simulator at Evans and Southerland Industries, Inc., Salt Lake City, UT, I recognized that in the 3D effect in a virtual reality setting, knowledge was being developed by the pilots using the simulator. At this briefing it became obvious that the virtual rality concept was applicable to EIS.

Executive information systems need to be developed to take advantage of on-line information transformed into knowledge through the use of decision support and other IT resources. By using an operational EIS, managers and end-users will be the individuals developing operational knowledge about the organization in a timely but iterative manner.

Most individuals are unwilling to admit that they do not know how to develop knowledge about a subject, or about an organization; yet it is true. Very little is taught about how to develop knowledge. Some do learn how to develop knowledge through trial and error, or through the influence of a mentor. Unfortunately, knowledge development is not a recognized objective of our education industry. Instead, students are exposed to voluminous information with the expectation that they will dig out the important items, remember them, and make proper application without further guidance. Much of this, it seems, is due to textbook authors and instructors making every effort to hide the gems of information that will provide knowledge.

KNOWLEDGEABLE INDIVIDUALS

Individuals are recognized as being knowledgeable in an area when they have attained a solid foundation in the subject and maintain an understanding of the leading developments in that area. Leaders in these areas are the individuals who contribute toward advancement of knowledge through research, development, and application. It is impossible for anyone to know all there is to know about a given subject. This makes it all the more important for individuals to learn to use sources of information for selecting data for information. Information alone does not provide knowledge or wisdom. Attaining wisdom implies more than learning facts and scoring well on multiple-choice exams. Two additional Rs are to be added to the **famous three Rs** for reading, writing, and arithmetic. One R is for reasoning (Latimer 1991) and the other R is the readiness for change (Eurich 1990, 267). The knowledgeable person can evaluate the information, select the items of importance that are useful in bringing about improved concepts, or ways of doing things, and implement the changes. An example in the education industry is the serious threats being made for the application of improved technology to the textbook industry (Cox 1993).

APPLIED INTELLIGENCE

The term **applied intelligence**, with the reference to software that **knows**, rather than software that **thinks**, appears to have merit. Whether or not the term applied is substituted for the term **artificial** in the future is hard to predict. However, the applied intelligence term occupies middle ground between the theoretical world of machines that think and those that remain dumb but powerful. Applied intelligence software knows enough to make some decisions due to the use of human experience and the learning capabilities of the software as it is used to solve cases over time (Schwartz and Treece 1992). A knowledgeable person will be aware of these and other capabilities in the subject area of interest.

There is a growing amount of **mindware** software available to meet the very needs previously identified. One well known example is **IDEAFISHER** from **Fisher Idea Systems, Inc.** in Irvine, CA. The software is an associative lexicon of the English language. A cross-reference system of words, phrases, and questions that help unlock creative thoughts and trigger new ideas. **Marshall D. Fisher** has continued to make improvements to this product through the years. The software is now available for use with Windows and has three add-on modules (IdeaFisher 1993). This is only one example of the many software products that are designed to be helpful for individual generation of new ideas and concepts. Students need to be aware of the availability and applications of these tools in the development of their own **creative** abilities.

In today's world, students need to learn to **groupthink**. The ability to work together is as much an asset as most anything learned that can be applied. This is the basic underpinning for the need for knowledge development students to organize themselves into teams of four or five students. As teams, they can develop relational database applications of their own design.

The next step is for the teams to participate in using **groupware** for **electronic meetings**. In the commercial world, **Electronic Meeting Systems (EMS)** have been installed in more than eighty universities and 400 organizational sites (Chen et al. 1994). For example, IBM uses **TeamFocus** for electronic meeting facilities that are available for use by corporations, government agencies, and others in the private sector. IBM has a number of dedicated electronic meeting facilities across the country available on a pay-per-day or part-day use (Miller 1992). Early software development for electronic meeting systems software was accomplished in university environments. Of the twenty or more software packages listed as **groupware** in late 1992, two were developed on campuses. One is from the University of Minnesota, a package called **SAMM**. The other is **GroupSystems V** developed at the University of Arizona (Groupware Report 1992).

Groupware is now divided into four recognized groups. The EMS reference above is in a category known as **meeting software**. **Basic groupware**, at present, recognizes **Lotus Development Corporation's Lotus Notes** as the only package in this group. The Lotus Notes is unique in that it combines a sophisticated messaging system with a giant database containing work records and memos. The other two categories of groupware are **workflow software** and **scheduling software** (Kirkpatrick 1993).

Abraham Zaleznik, the Konosuke Matsushita Professor Emeritus of Leadership at the Harvard Business School points out that the trend toward teams, process and collaborative decision-making is eroding the leadership of today's organizations. Zaleznik believes that managers and leaders are very different. Managers continually coordinate opposing views among subordinates and work toward consensus. In contrast, leaders do not simply draw upon the resources of others; they bring their own talents to the table. In Zaleznik's opinion, he thinks teams are popular because a lot of managers are scared to death of accountability; and

furthermore, they are ducking it by forming task forces and working collaboratively (Kiely 1993).

Professor Zaleznik's views are accentuated by my own experiences as an Army officer. Military situations require leadership where one individual takes responsibility for the organization and is held responsible for his or her actions. A Military Court is relied on to decide the penalty when those actions are not in accord with established policy. The system does not always work, as some exceptions have shown; however, when the concept is applied without political interference, there are many more examples where true leadership is recognized. This is especially true during times of war when political interference is not as easy to apply as it is during peace.

KNOWLEDGE SOCIETY

There have been previous references to a knowledge society. Two examples are included. **Nell Eurich** pointed out the importance of human resources for the knowledge society (Eurich 1990, 2), and **Peter Drucker** identified how the GI Bill of Rights signaled the shift to a knowledge society (Drucker 1992). Drucker later identified in his Post-Capitalist Society the key question of what constitutes the educated person in the society of knowledges? His answer is in the last chapter where he asserts that knowledge is always embodied in a person; carried by a person; created, augmented, or improved by a person; applied by a person; taught and passed on by a person; used or misused by a person. He believes that the shift to the knowledge society puts the person in the center (Drucker 1993,47,210).

E.D. Hirsch, Jr. pointed out in his 1987 book, Cultural Literacy, that the single most disastrous mistake of American schooling during the past forty years has been the misguided emphasis on **skills**. The cultural literacy concept is now being implemented as **Core Knowledge** (Core Knowledge 1993). The knowledge development concept builds on the Core Knowledge concept and focuses on the use of information technology tools for the access of data, the selection of information, and the development, storage, and review of knowledge.

Core Knowledge

Not many years ago, it was common to identify a student's level of knowledge with grade completion. For example, the completion of a specific grade generally insured that the student knew certain multiplication tables. The influx of calculators may have erased this level of understanding. However, there is need for an accepted level of knowledge to be associated with grade level completion. Professor Hirsch founded the **Core Knowledge Foundation** in Charlottesville, VA. The objective of this effort is to make available the tools designed to provide elementary school children with a core of knowledge. The Core Knowledge concept advocates the teaching of a **carefully sequenced** body of information in a broad range of subject areas. The Core Knowledge Foundation was founded in 1986, and the Core Knowledge Sequence was developed in 1990, field tested at Three Oaks Elementary in Ft. Myers, FL, revised in 1992, and updated in 1993. The concept

is being used in an increasing number of schools across America (Core Knowledge 1993). This development appears to have been overlooked in the controversy over national tests and standards imposing rigidity in the classroom (Celis 1993).

A number of students are confused by the excessive amount of detail demanded by their instructors. For example, a neighbor's child, a high school junior, has five notebooks; one for each of five courses. Each notebook is required to be a two-inch, three-ring binder, and each organized in a separate way to meet the preferences of each teacher. The days of having one large, three-ring binder, with five dividers, are gone! In addition, the **Cornell Note Taking** concept is introduced in the lower grades and continued through high school. No doubt, all students can profit from improved note taking; however, each teacher has her or his own concepts of how to take notes. The students are graded on the note taking and the organizational arrangement of their notebooks. Students believe this amount of detail to be, as they describe it, "**Mickey Mouse instruction.**" With each teacher implementing their own preferences, it is easy to see how the students are confused by over-organization. It appears that there is an imbalance in the curriculum.

AN EDUCATED VS A KNOWLEDGEABLE PERSON

An educated person differs from a knowledgeable person in that an individual may be well educated, with numerous degrees from well-recognized universities, but without creativity, experience, understanding, insight, or reasoning abilities to apply the education. A knowledgeable person possesses these attributes and is able to apply them. Due to today's methods of measurement, a knowledgeable person may or may not possess a high degree of intelligence. A person with lower intelligence than others may take longer to make the decisions, but the individual's decision may be as valuable, or more valuable, than the person believed to have higher intelligence who makes the decisions much faster.

Corporate America is finally recognizing that "the most critical knowledge may turn out to be self-knowledge," according to **Walter Kiechel III's** "A Manager's Career," which appeared in the 4 April 1994 issue of Fortune magazine (Kiechel 1994). Unfortunately, the accompanying article by **Thomas Stewart** describing "The Information Age In Charts" identifies only the computer and communications industries as making up the Information Age. The information, education, and entertainment industries were omitted. However, Stewart does identify **wetware** as being **what you have between your ears**. He also points out that one human genome is equal to one and one-seventh compact disks, 536 1.4MB floppy disks, or 399,000 pages of text. In summary, these authors realize that corporate America requires individuals to be prepared to specialize, to market themselves, and to have work, if not a job (Stewart 1994a). **William Bridges** said that in his opinion the job is disappearing, vanishing like a species that has outlived its evolutionary time (Bridges 1994). It is hard for many to realize that this change is going on.

KNOWLEDGE SOCIETY DEFINED

The **knowledge society** is a continuously developing society, building on the foundation of the information society in a never-ending **iterative manner**. The knowledge society will resemble a **kaleidoscopic environment** as the different resources from the various industries are integrated into the society as a whole. Individuals will become recognized as the major resources of the knowledge society and will build on present-day concerns with computer processing of information by using their human brains for the processing of knowledge. The brain will take advantage of its fuzzy logic capabilities, an enhancement over the current **on** or **off**, **yes** or **no** capabilities of computers. In this environment, an individual's brain will use the information technology tools in a **virtual reality environment**, without having to think about skills or tools, but with instinct about using the most appropriate resources and then applying the best solution or decision. This transition from current learning environment of stressing information technology tools and skills will not be easy; however, properly guided research efforts and a willingness to change, experiment, and implement, will make the changes possible.

KNOWLEDGE INDUSTRY

The developing knowledge society includes the implementation of the **knowledge industry**. The knowledge industry will build on the integration of selected resources of the other industries that support the information society. The term selected is used to identify those resources that need to be integrated in the knowledge development efforts, rather than treated as separate information technology tools and skills. For example, the consolidation of effort within information society industries, such as communications and computers, TV and the telephone industries, and the influx of the entertainment industry into the information society arena, are all indications of what is ahead for the knowledge industry: to bring together the knowledge-producing portions of all these efforts and mold them into true knowledge development.

The information technology (IT) portion of the information society has developed many excellent resources during the past half-century; unfortunately, results from efforts to truly integrate these resources have been lacking. This is due, primarily, to a lack of education and willingness on the part of the knowledgeable individuals to work with others in different areas. Students study most of the IT resources as tools or skills. The educators leave the integration of these tools and skills up to the students, basically telling them to figure our how to make it happen on their own. This lack of integration is changing in many areas. The changes will take place much more rapidly with improved education. Examples of these areas, although not all-inclusive, are **operations research**, **artificial intelligence**, **simulation**, **fuzzy logic**, **multimedia**, and **virtual reality**. Collectively these can contribute toward the development of the knowledge industry in support of the knowledge society.

Operations Research (OR)

Many attribute the U.S. interest in operations research as originating during World War II when our forces were allied with the British. One of the early uses and subsequent acceptance of OR was in the optimization of bombing missions on the European continent. Later, the U.S. military and, in particular, the **Weapons Systems Evaluation Group (WSEG)** in the Office of the Secretary of Defense introduced many of the concepts used in the private sector. A corporate component of WSEG, the **Institute for Defense Analysis (IDA)**, contributed much toward the expansion of the OR effort. Many corporations and other organizations formed OR groups to provide support for various functional areas. The author learned the advantages of having the OR professionals integrated into the functional areas they serve while observing this transition at the Weyerhaeuser Corporation. This visit was made during the early 1970s when my MBA class was invited to visit the corporate headquarters near Tacoma, WA. Over time, most of these individuals were integrated into the functional areas they had previously been supporting.

From an academic view, OR emerged from applied mathematics and was supported by statistics and industrial engineering. All three disciplines gave early recognition and often provided an academic home for OR faculty. The use of models to describe a particular problem for the application of an OR approach is fundamental. For example, a **task scheduler** is a program assigning tasks in priority to a computer's CPU for maximizing throughput, which is an OR solution. Another example is the mix of computer jobs originating in research areas vs. those originating in academic areas. With a single mainframe computer, the problem is to balance the input of jobs to provide the highest satisfaction level. A third example, also drawn from the **Greenberg** and **Nance** discussion, is a queuing problem to optimize the access to data stored on a fixed-headed disk to minimize the total access time. The derivation and design of algorithms has dominated OR throughout its history and, by so doing, has brought OR and computer science closer together (Greenberg and Nance 1993).

Artificial Intelligence (AI)

The field of artificial intelligence is considered to have been founded during a conference at Dartmouth College in 1956. The conference was organized by **Marvin Minsky** and **John McCarthy**. Credit is given to McCarthy for coining the name **artificial intelligence**. They described AI as a field of computer science and engineering concerned with the computational understanding of what is commonly called intelligent behavior, and with the creation of artifacts that exhibit such behavior (Shapiro 1993). **Sprague** and **McNurlin** point out that **intelligent systems** is the new term being used for real-world uses of artificial intelligence. However, they continue to identify expert systems, neural networks, fuzzy logic, machine translation, speech recognition, and natural language as AI technologies. They also identify **decision support systems (DSS)** as originating in the fields of management science and operations research. DSS systems

are designed to support, not replace, managers in their decision-making activities. Computer graphics, spreadsheets, institutional and quick-hit DSS systems are also included. It also is pointed out that DSS products are incorporating AI tools and techniques (Sprague and McNurlin 1993).

Prior to the above references to a knowledge industry, major efforts were made to develop **knowledge-based systems** in the field of artificial intelligence (AI). These knowledge-based systems are one branch of artificial intelligence known as **expert systems**. An expert system is a computer program or a computer-based system designed to act as an expert in a particular area of application. In some cases, as in a prototype application of an expert system developed at the College of William & Mary for student aid and grants, the student could sit at a computer and determine whether or not eligibility requirements were met. In most cases, expert systems are used to assist the decision-maker rather than assume the role of making the decision.

An expert system uses the expertise of human experts who are knowledgeable in a specific application area. A **knowledge engineer** obtains the knowledge used by the expert and builds the knowledge base used by the expert system. Diplomacy, the ability to get along with people, and the use of cognitive psychology are more important to the knowledge engineer in obtaining the knowledge from the expert than other technical skills. An **inference mechanism** as a part of the expert system makes inferences based on its interpretation of the representation of the expert's knowledge. **Rules** are the most common form of knowledge representation in expert systems. In some respects, rules are similar to **if-then** statements of programming languages. For example, **if** this statement is **true, then do that. If** the statement is **not true**, then there is need for the system to **branch to a different set of procedures**. Unfortunately, in many problems, the conditionality is so great that the number of paths grows explosively, often beyond the capabilities of the system (Rauch-Hindin 1986).

Expert systems are used in most industries, corporations, banks, and hospitals. Common uses are in the location of oil and mineral deposits, equipment maintenance, stock analysis, and medical diagnosis with patient mortality prediction. One corporation, the **E.I. du Pont de Nemours & Company, Inc.** has been a leader in applying expert systems. **Edward G. Mahler** was the leader of their implementation. Of importance was Dr. Mahler's concept that the company would benefit the most from creating many small expert systems rather than a few large ones. Of even more importance was his end-user approach to development and use, similar to the use of word processing software, or spreadsheets. As a result, du Pont has hundreds of expert systems in use that have been developed by the end-users. Mahler recognizes the need for knowledge management to build on the analysis of information for decision making. This is a third step, the first being data obtained from transactions, and the second, the processing of the data into information. The knowledge management step is analyzing

the correct or relevant information, at the point where the decision is to be made, with sufficient time to make the analysis and to make the decision (Mahler 1989).

It appears that **knowledge engineering research** is heading in the direction of a recurring theme that knowledge acquisition is a modeling process, not merely an exercise in "expertise transfer" or "knowledge extraction," (Ford and Bradshaw 1993). It is hoped that knowledge engineer professionals will incorporate the knowledge development in their future research.

An example of the application of **knowledge engineering** is an automatic classification system called **Parallel Automated Coding Expert (PACE)**. The objective was to assist the U.S. Census Bureau in classifying an estimated 22 million natural language responses to questions on the 1990 Decennial Census into one of 232 industry categories and 504 occupation categories. PACE is essentially an expert system driven by knowledge extracted from human experts and tested via the same preclassified database (Creecy et al. 1992).

Artificial intelligence has been a goal of computer scientists and others for over three decades. The term appears to have made computers compete with humans rather than continue to augment human decision making. It is well known that computers can do many things better than humans, and that humans can out perform computers. It is also realized that in combination, computers and humans can accomplish what neither can accomplish on their own. An objective of the knowledge development is to emphasize the combination of the capabilities of humans and computers, eliminating the stress on tool subjects. Remember, there are thousands of examples not discussed because of their proprietary nature and the competitive environment of their users.

Other areas are **neural network, chaos theory, genetic algorithm, number theory, and nonlinear equations**. A neural network is more sophisticated than an expert system, attempting to mimic human brain processes and learn from its mistakes. Chaos theory holds that seemingly random events actually have patterns that computer programs can detect. These are used in analyzing the behavior of securities markets. Genetic algorithm is a problem-solving technique useful in handling and identifying anomalies or deviations from the common rule (Light et al. 1992). Number theory originated in ancient Greece. The applications of computers have provided many new ways to apply the concepts in solving many tough problems. Some say that number theory may be the key to developing computers that mimic the human brain (Guterl 1994a). Nonlinear equations are used for precisely describing the behavior of things the way they work in the real world (Guterl 1994b). These references to other tools and techniques are included to point out that there are numerous aids available and new ones under development for use in knowledge processing. These tools and others under development merely add to the ever-increasing total of information technology tools referenced previously.

Simulation

Simulation is a tool the author used in the classroom during the 1970s. At that time the application was a train performance simulation serving the old Missouri Pacific Railroad (**MOPAC**), in St. Louis, MO. MOPAC is now a part of **Union Pacific Railroad**. After the merger, the simulation application was moved to Omaha, NB, the operating headquarters for the Union Pacific. In Omaha, the simulation uses a 100-yard-long screen to give dispatchers control over 10,000 miles of track. Among other simulation results is an opportunity to schedule the operating time for a train, determining the amount of locomotive power to use, the tonnage involved, and make what is similar to an airplane flight plan, including weather considerations.

A more current example of the integration of a simulation application into an academic environment is at the **Kennedy School of Government**. The simulation is based on the 1979 accident at the **Three Mile Island** nuclear facility in Pennsylvania. The application allows students to play different roles in dealing with the situation. They can fulfill the role of press secretary in the power plant, in the governor's office, or at the Nuclear Regulatory Commission. Another role is that of a reporter covering the crisis. A student's decisions can be graded at the end of the exercise. The simulation example was designed and developed by **Jerry Mechling** and **Thomas Fletcher** of the school's computing and telecommunications program (Fletcher 1993).

Another example of classroom use of simulation is at **Texas A&M**. As reported by **Professor Hans Juvkam-Wold** who holds the **John Edgar Holt Chair in Petroleum Engineering**, the drilling simulator equipment fills an entire laboratory. Students using the simulator experience the sights, sounds, and feel of operating an actual drilling rig. Complex software teaches students to react to problems that could prove costly and dangerous if encountered in reality (Texas A&M 1994).

Fuzzy Logic

Knowledge of an area is most always incomplete and uncertain. Expert systems have a built-in method of dealing with these uncertainties, called a **confidence factor**. This factor can be applied and changed by the user by combining his or her confidence in the answer with the knowledge engineer's maximum degree of confidence that can be obtained by applying a rule. An alternative method, called **fuzzy logic**, was created by **Lotfi A. Zadeh**, a recently retired professor of computer science at the University of California at Berkeley. The concept was designed to let computers work with imprecise terms like **warm**, **tall**, **few**, or **many**, rather than the precise **on** or **off**, **yes** or **no**, typical of computers. Dr. Zadeh was born to Iranian parents in the Soviet Union; he graduated from the University of Teheran and earned a Ph.D. from Columbia University. His first paper on fuzzy logic was published in 1965 when he was chairman of the Electrical Engineering and Computer Science Department at Berkeley. Computer scientists have not ignored the need to handle approximate information; they use other approaches. One approach is based on

probability theory. A newer approach is called qualitative physics (Pollack 1989).

The previous reference to the 1971 era when **Milt Bryce** was telling his customers that he was "developing software of the finest computer-the mind" is repeated because of the similarity to lack of acceptance in U.S.A. to quality control. The Bryce methodology at that time was **PRIDE**, an acronym for PRofitable Information by DEsign - through phased planning and control. It was later expanded to include the entire product line and the methodology was referred to simply as the **Information Systems Engineering Methodology (ISEM)** (Bryce and Bryce 1988). The lack of reception within U.S. of the teachings of the late **W. Edwards Deming** and his **statistical quality control (SQC)** and **J. M. Juran's total quality control (TQC)** are well known. Milt Bryce and his concepts are also much better known and used in Japan than in the U.S.A. These mistakes should help us appreciate the fact that Fuzzy logic presents a similar situation in that Japan dominates the market in fuzzy logic chips for use in applications from cement kilns to household appliances and other electrical products. The Ministry of International Trade and Industry (MITI) estimates that in 1992, Japan produced about $2 billion worth of fuzzy products (Kosko and Isaka 1993).

Professor Zadeh, in an April 1988 article in Computer magazine, wrote that "fuzzy logic aims at modeling the imprecise modes of reasoning that play an essential role in the remarkable human ability to make rational decisions in an environment of uncertainty. This ability depends, in turn, on our ability to infer an approximate answer to a question based on a store of knowledge that is inexact, incomplete, or not totally reliable," (Zadeh 1988). During the **ACM Computer Science 1994 Conference** in Phoenix, Professor Zadeh pointed out that most of the applications of fuzzy logic relate to control in the context of industrial systems and consumer products. He explained that there is a trend toward the use of fuzzy logic in task-oriented applications, rather than set-point oriented control. In his opinion fuzzy logic has succeeded where traditional approaches have failed because fuzzy logic does come to grips with the pervasive imprecision of the real world. Zadeh observes that the role model for fuzzy logic is the human mind (Zadeh 1994). This adds to the foundation for the concept that the knowledge society should be making use of the human brain as the computer to provide the engine for knowledgeable individuals.

Multimedia

Previous references have been made to the importance of multimedia to the information industry using CD/ROMs for storing portable databases; to the communications industry and its ability to move multimedia data at fantastic speeds; and where desk-top publishing is now accepted. In spite of the efforts by numerous organizations supporting the education industry, the acceptance and implementation of multimedia within the education industry has been disappointing. Unfortunately, less than half of the responding institutions to the CAUSE Institutional Database

Survey report use of **multimedia software** in the classroom. Most of those reporting indicated utilization at the one to ten percent level. The most common range of faculty using computing in the classroom is eleven to thirty percent (CAUSE ID 1993).

Previous reference was made to the **Institute for Academic Technology (IAT)** at Chapel Hill, NC, where outstanding work in multimedia applications continues (Graves 1993). A recent addition is the **New Media Centers Program**, a consortium of high-tech companies and twenty-one academic institutions, has supported a Stanford University multimedia laboratory for a year. The academic members were selected from a pool of 138 applicants. Companies in the consortium include Apple Computer, Inc., and Prentice-Hall, Inc. (Chron. 1994).

Multimedia capability is a goal being obtained by the information society. The knowledge society must encourage the attainment of this goal, and take advantage of the developments as they are identified within the knowledge industry.

Virtual Reality

The term virtual reality has been defined as a way to visualize, manipulate, and interact with computers and extremely complex data (Aukstakalnis and Blatner 1992). The literature today dwells on the interfaces: the ways to interact with computers and to visualize information. Typical examples are aircraft pilot simulators such as those manufactured and demonstrated by Evans & Southerland, Salt Lake City, UT, referenced previously. The NII uses the example of students taking **virtual field trips** to museums and science exhibits without leaving the classroom. These and other types of virtual reality need to be expanded into most subjects and disciplines.

Hand gestures have been captured in numerous ways by a variety of individuals and companies. As the hand is moved, gloves are designed to pick up the movement and send input instructions to a computer. A more common example is when a student holds a pen or pencil, the object becomes a part of the individual as he or she writes or draws. The human brain operates the pen or pencil in a virtual reality environment.

Through virtual reality existing theme parks are being threatened by anticipated changes. **Disney** is being challenged by a concept that **Sega Enterprises Ltd.** is attempting to exploit. This concept offers the efficiency of electronics over iron and steel to create a new entertainment form: virtual-reality theme parks. According to **Brandt, Gross, and Coy**, in a Business Week article, they observe that instead of building roller coasters and ersatz Bavarian castles, visitors will be placed inside windowless, truck-size capsules and make them feel as though they're driving a race car or piloting a spaceship. For example, **Sega VirtuaLand**, an experimental arcade at the new Luxor Las Vegas hotel, gives a sense of what's to come (Brandt, Gross and Coy 1994). This is the type of change needed to take the education industry into the era of the knowledge society making use of the NII resources.

NII PROMISE

The National Information Infrastructure: The Administration's Agenda For Action Version 1.0 does not mention the knowledge society; however, the "promise of the NII" is a de facto description of the developing knowledge society. The following is a complete quotation of the NII promise:

> Imagine you had a device that combined a telephone, a TV, a camcorder, and a personal computer. No matter where you went or what time it was, your child could see you and talk to you, you could watch a replay of your team's last game, you could browse the latest additions to the library, or you could find the best prices in town on groceries, furniture, clothes -- whatever you needed.
>
> Imagine further the dramatic changes in your life if:
>
> The best schools, teachers, and courses were available to all students, without regard to geography, distance, resources, or disability;
>
> The vast resources of art, literature, and science were available everywhere, not just in large institutions or big-city libraries and museums;
>
> Services that improve America's health care system and respond to other important social needs were available on-line, without waiting in line, when and where you needed them;
>
> You could live in many places without foregoing opportunities for useful and fulfilling employment, by 'telecommuting' to your office through an electronic highway instead of by automobile, bus or train;
>
> Small manufacturers could get orders from all over the world electronically -- with detailed specifications -- in a form that the machines could use to produce the necessary items;
>
> You could see the latest movies, play the hottest video games, or bank and shop from the comfort of your home whenever you chose;
>
> You could obtain government information directly or through local organizations like libraries, apply for and receive government benefits electronically, and get in touch with government officials easily; and
>
> Individual government agencies, businesses and other entities all could exchange information electronically -- reducing paperwork and improving service," (NII 1993).

KNOWLEDGE SOCIETY HIGHLIGHTS

The NII agenda, stated in Chapter 5, outlines the need for action to be taken for Americans to compete internationally and enjoy a healthy democracy. The NII promise, quoted above, although without direct reference, outlines many of the accomplishments to be obtained from the developing **Knowledge Society**.

The knowledge society as described in this report is not new as numerous examples demonstrate. What is new is the attempt to redirect existing efforts, making better use of those resources

that are available, and recognizing that a knowledge industry is developing to support the knowledge society.

As stated previously, the knowledge society is a continuously developing society, building on the information society foundation in a never-ending iterative manner. The knowledge society will resemble a kaleidoscopic environment as the knowledge industry uses the resources of the various industries and integrates them into the society as a whole. A major resource is to be derived from those developments within the information technology portion of the information society that have been implemented during the past half-century.

Data and information are necessary resources for knowledge; however, knowledge requires more than information. Computers are the most important tool for acquiring data, extracting information, and obtaining knowledge. In combination, humans, computers, and communications working together are necessary to accomplish true knowledge development. The resources are available. What is needed is the leadership to identify the resources available, select those required by the knowledge industry for the support and implementation of the knowledge society. Recommendations are in the following chapter.

(Note: The controversial book The Bell Curve and further discussion of the importance of intellect has been omitted from this discussion.)

7. DEPARTMENT of KNOWLEDGE DEVELOPMENT

The major objective for the knowledge development concept (KDC) is to prepare individuals to be self-sufficient to compete in a very competitive environment. This means that individuals can no longer rely on lifetime employment with an organization. Instead of preparing for jobs, students of all ages must equip themselves with knowledge that will be in demand by many different organizations. Although the concept must include providing opportunity to learn how to work in groups and as teams, it is individual leadership where the greatest rewards will be found. To meet the objective, the knowledge development concept will redirect the national educational and training efforts toward meeting the needs of the knowledge society.

Preparing for this redirection is a major national effort, like building the atomic bomb or landing a man on the moon. These efforts required the **Manhattan Project** and the **National Aeronautics and Space Administration (NASA)**. There are many competitive organizations and political factions attempting to gain an advantage in the development and operation of the NII. The Report of the Information Infrastructure Task Force Committee on Applications and Technology identified eleven Federal agencies in active support of the development. In addition, there are 50 state legislatures, governors, vendors, corporations, consultants, lobbyists, union leaders, politicians, and school administrators, attempting to gain control. As we learned from the atomic bomb and the Apollo missions, an organization is required to direct a major national effort.

KNOWLEDGE DEVELOPMENT AGENCY/DEPARTMENT

Congress and the present administration need to support a bipartisan effort by creating a **Knowledge Development Agency** for the implementation of the knowledge development concept, and the creation of knowledge as a national objective. The implementing NII and the development of knowledge will continue to be iterative efforts, each supporting the other.

A major objective of the knowledge agency is to guide the evolution of a new **Department of Knowledge Development** to be formed by the merger of the Departments of Education and Labor. These two departments are often charged with retaining the status quo. The labor department appears to be oriented toward training-for-jobs, jobs, and jobs; and education seems dominated with information technology, statistics, and grants. Both need the support of the unions to meet the new objective of developing knowledge. All concerned need to support each other in changing America in the way education and training are being conducted. This national effort will make a difference.

This realignment of two major departments within the Executive Branch will not require reorganization of the Standing Committees of the Congress because the House Committee is **Education and Labor** and the Senate Committee is **Labor and Human Resources**.

The expanding vastness of the information resources make it necessary for all concerned to become familiar with the available

data resource locations and the selection of those data needed to meet information requirements and knowledge being developed. The knowledge must be stored, made available for access, iterative evaluation, and update. Much progress has been made in the transmission of voice and text data. Now that multimedia demands improved communication networks, there is need for greater understanding of, for example, networked video, and the additional requirements to use the World Wide Web, or its successor.

Computers are recognized as the key resource in the information society. However, with the increased demand for multimedia access and storage, computer upgrades are a high priority. This upgrade is required by most personal computers in spite of the fact that many are equipped for use with CD/ROMs. With the upgrades of both communications and computers, the knowledge society will mature with the help of the knowledge industry. The resources of the information, education, and entertainment industries are of equal importance to the developing knowledge society as are the computer and communications industries. For example, the education industry should draw on resources of the entertainment industry to add enjoyment to the education process.

Bipartisan Efforts

Until **Lamar Alexander's** Breaking the Mold in a special advertising section of Business Week described **Goals 2000**, recently enacted by Congress, as legislation that "nothing could be worse for our schools," it appeared that there was bipartisan agreement (Alexander 1994). This is but one example of the need for national leadership in obtaining a knowledge development objective, in spite of party politics.

Private Sector Knowledge Development

Since **Nell Eurich** pointed out in her 1990 book The Learning Industry that on any count, corporations appear to be the largest providers of adult education (Eurich 1990,18) the education industry has continued to fall further behind. This comment is reinforced by **Davis** and **Botkin** in their book The Monster Under the Bed. The subtitle is "How Business is Masterintg the Opportunity of Knowledge for Profit," (Davis and Botkin 1994). The resources of the private sector can provide major contributions to the development of knowledge within the country. These resources are not to be overlooked.

NII Implementation

The knowledge agency and the new department will need to provide the centralized de facto leadership for the continuing development and implementation of the NII. The NII will provide the tools used in the national knowledge development effort. Without this leadership there is fear that the nation may be deprived of technical advances similar to the previous reference in Chapter 3 of our failure to enjoy frequency modulation (FM). Due to the commercialization of the Internet, the all-too-powerful profit motive reinforces my concern.

International Education

The new agency and the new department should plan to implement leadership in international education. The Internet makes this possible. The **Institute of International Education** in New York City can provide guidance (Desruisseaux 1994).

Student Honor Code

The Knowledge Development Agency can make a major contribution by requiring all academic institutions receiving federal funding to enforce an **honor code** for all students. For example, the service academies of the Air Force, Army, Navy, and Coast Guard are recognized for their leadership in honor code implementation. However, special efforts are necessary for them to eliminate the widespread distaste for accusing one's classmates. The service academy graduates can do much to eliminate the unfortunate status of so-called **whistle-blowers** throughout government and the nation. This action will enhance the efforts to reinvent government, making life easier for the Justice Department and the General Accounting Office.

National Software Crisis

Through improved leadership, the Knowledge Development Agency can bring about cooperation and coordination to change the method of instruction to eliminate the crisis within the software industry. There is sufficient documentation to acknowledge that the methods now in use are not providing the knowledge necessary for successful software development. The previous reference to the Denver International Airport fiasco is only one example where something needs to be done. Greater recognition is needed for the support of the research and development of reusable programming code; and in the development of a common software infrastructure for use in replacing approximately eighty percent of the programming code used in applications software. More specifically, these efforts are underway at the Space & Warning Systems Center, Peterson AFB, CO, described in Chapter 5. This effort is under the guidance of ARPA in the DoD and the Assistant Secretary of the Air Force (SAF/AQK) for Acquisitions.

Libraries as Knowledge Centers

Libraries can no longer afford to be recognized by the number of books and other documents in their collections. Evaluation of libraries should be based on how well they provide information for knowledge development. Previous references were made to progress at OCLC, Dartmouth College, Wichita State University, the National Electronic Library model recommended by Brian Hawkins, and New York's SIBL. The prototype **virtual library** under development at Emory University may provide an example worthy of imitation (EDUPAGE 1993). The results from a much larger, $24 million, effort to digitize materials in six university libraries over the next four years should attract national attention (DeLoughry 1994a). The extent of library decentralization to make the information more readily available within the areas of direct interest is of growing concern. Decentralization of libraries may encourage some newer organizational concepts, such as the elimination of the pyramid

(hierarchical) organization in favor of the **horizontal organization** (Byrne 1993).

Data Retrieval

Greater recognition and additional support should be given to the **ARPA TIPSTER** project described in Chapter 2. This effort has been underway since 1990 and entered Phase II during April 1994. This project can contribute much toward the future use of the NII resources.

Vendors For Student/Home Computers

Vendors need to be encouraged to provide a custom version of the personal digital assistant (PDA) as a student computer that can be priced within student and household budgets. The need for personal information management (PIM) software must be recognized and provided. By using the calculator as an example of what mass marketing can accomplish for the price of a product, the PDA can become a major breakthrough for the future of the Internet and the NII. With PDAs in the homes interfacing the TVs and the Internet, the knowledge society and the NII can become realities. School computer laboratory costs can be reduced.

Core Knowledge Foundation

The concepts of the **Core Knowledge Foundation**, Charlottesville, VA, developed by Professor E.D. Hirsch at the University of Virginia, should be recognized and implemented throughout the nation. It appears that core knowledge should also apply to high school students.

Schools Operating Year-Round

The operation of schools year-round needs support and implementation. This concept was introduced years ago by Superintendent James Bradford, Jr. in the Buena Vista VA City Schools. The concept has been implemented through a National Association for Year-Round Education with 2048 schools in 26 states participating. This does not mean that students and teachers are to be in class year-round, but with staggered vacations. All K-12 schools should be encouraged to become year-round centers for the communities where they are located.

K-12 Schools As Centers of Communities

Each center will provide a nucleus for the community to work together. These centers can be used as knowledge development centers for both students and those taking advantage of life-long learning. For example, this is where a community should go to learn how to access and use the **Internet**. The experiences from the **Blacksburg Virginia Electronic Village** efforts can be used as a guide in the community center implementation. For example, anyone with a modem and a PC now has access to the electronic filings of the **Securities and Exchange Commission**, the world's most valuable collection of financial data (Flynn 1994).

Distance and Life-Long Learning

Faculty and students in the knowledge development courses are encouraged to observe how **distance learning and life-long learning** are provided on campuses. Their study should include the progress being made through **Project DELTA** at the California State University System. The objective of this project is to make

information technology and distance learning integral parts of the system's instructional program (West and Daigle 1993). The Cal State system includes twenty campuses and over 300,000 students with alarming growth projections (DeLoughry 1994b).

In order to take greater advantage of the resources available for distance learning, there is need for recognition of specific colleges, universities, and private sector programs to provide opportunities in disciplines where leadership has been demonstrated. Such recognition, through the use of distance learning, could reduce the costly teaching load now being attempted by schools with an unjustifiable number of students in these disciplines. Proper supervision, based on evaluations, could help eliminate those programs that are below expectations and excessively costly. By encouraging students to make use of distance learning within states and across state lines, much money can be saved by reduced administrative, faculty, staff, and physical support for classes no longer required.

Teacher Preparation and Conduct

There is a need for national leadership in the improvement of the way teachers are educated and prepared for their roles as teachers in a knowledge development environment. An extension of this leadership is required for making improvements in the way teachers carry out their duties in the classroom. This preparation applies primarily for those who enter the K-12 classrooms. However, the efforts need to be extended to the preparation of faculty for colleges and universities. This seems especially true for undergraduate teaching where much effort is expended to avoided undergraduate classes wherever possible. **Gordon Winston**, in his article on **"The Decline in Undergraduate Teaching"** gives an excellent summary of the situation. In this article he includes an understanding of the problem of **discretionary time** and the value placed on it (Winston 1994).

Cooperating With Many Organizations

There are many organizations with national interests attempting to make contributions for the betterment of the nation as a whole. Many of these organizations are funded by the private sector where most generous funding is provided. Chapter 5 identified a large number of contributing oganizations toward making improvements in the education industry. Examples of cooperative efforts in previous discussion are **CNI** and **CHEMA**. The **CAUSE Information Resources Library**, formerly the **Exchange Library**, in Boulder, CO, is another example of a major effort to provide documentation of many results from contributing individuals and organizations. These efforts are worthy of recognition; however, there is need for greater attention and effort on a national scale. There are many industries, in addition to education, having their own supportive organizations.

FORMULATING KNOWLEDGE DEVELOPMENT COURSES

It appears that there are at least two approaches to expanding the knowledge development concept through college and university education. One approach is through the development of courses designed to educate students in knowledge development for

their application in any course they undertake. The other approach is to include knowledge development in the introductory level instruction in each discipline. The latter would place the responsibility on department heads to implement the instruction. The former would be the responsibility of the provost or executive vice president.

Consortium

No one individual is qualified to design and develop appropriate knowledge development instruction material for either approach. Therefore, it is recommended that a consortium be organized to develop the courses. The consortium should to made up of representatives from the AAHE, ACM, ALA, CAUSE, EDUCOM, IEEE, SIM, American Medical Informatics Association, and others from training areas, to prepare knowledge development courses for each discipline. Representative disciplines are included in the following discussion. The course materials should make extensive use of multimedia format and incorporate the results of virtual reality research and development. Each discipline will need to furnish the information resources peculiar to that area. The consortium should provide the common subject matter for use in all disciplinary courses. This consortium can become a major asset to assist in evaluating other recommendations included in this chapter.

The consortium members can draw on the experiences of the National Science Foundation Task Force in their development of the new discipline **Informatics**, referenced in Chapter 5. This new discipline may prove to be an ideal area for a knowledge development course as an introductory course. Such an introductory course could prove to be the knowledge development course for many disciplines. The **CUPLE** Project can also become an example for structuring the knowledge development course preparation and implementation. The **IAT** operated by UNC at Chapel Hill will prove to be a major resource. Another resource for a knowledge development course for **music** would include an introduction to the latest use of technology extracted from the **Music Technology Center, University of Northern Colorado** in **Greeley** (Monaghan 1993).

Knowledge development courses are needed for the **Community Colleges** and the following disciplines:

Engineering--Aerospace, Chemical, Civil, Computer Science,Electrical, Mechanical, Nuclear.

Humanities--Area Studies, Communications, English (Literature or Composition), Journalism, Foreign Languages, Philosophy.

Mathematics--Algebra, Calculus, Geometry, Statistics.

Natural Science--Astronomy, Atmospheric Science, Biology, Botany, Ecology, Forestry, Genetics, Zoology, Chemistry, Geology, Physics.

Social Sciences--Anthropology, Archaeology, Accounting, Business, Economics, Geography, History, Political Science, Psychology, Sociology, Statistics, Research Methods.

Law and Medicine

The consortium will need to hold seminars to educate faculty to teach the knowledge development courses. Past experiences of the AACSB in post-doctoral education of several hundred instructors to teach MIS courses can provide guidance. The developing MIS faculty, as students, spent their first summer at the University of Minnesota under the guidance of **Gordon Davis**, and the second summer at Indiana University taking advanced work directed by **A. Milton Jenkins**.

Knowledge Development Course Objectives

The major objective is to teach students to identify information resources for each area and know how to evaluate and obtain those data suitable to providing information for use in knowledge development, then organize the results for future evaluation and possible expansion, or elimination, as new information is obtained. Students will generate course information recorded by their own computers in databases and discs for update during their life-long learning. Just as some old textbooks are many adults' best friends, these computer-supported devices will be much more accessible and updatable.

It was explained previously how end-users and their functional area managers need to take more active participation in application development teams. By educating students in managing information as both an individual and organizational resource, the country will develop a foundation of individuals able to utilize the advantages of information technology. This will permit the IT professionals to spend more time on the leading edge of their professions, and reduce the time they spend now in developing applications for functional area users.

As the new knowledge development courses are implemented at the college level and the K-12 teachers are educated, the concept will trickle down to the K-12 classes. The representatives developing the courses will need to draw on the experiences of the leading faculty members in each discipline who have developed recognized courses and are willing to expand their concepts into the development of knowledge.

Entrance Requirements

The computer entrance requirements referenced for undergraduate business school programs is a step in the right direction. This level of proficiency needs to be expanded to information technology instead of merely computer understanding of word processing, spreadsheets, and databases. Prior to receiving a high school diploma, students should have experienced voice mail, E-mail, an improved method of programming, software for automated computer code generation, be able to download and upload on both a mainframe and a LAN, and access the Internet. The instruction must recognize the need for multimedia access as the technology becomes available. This proficiency is needed to equip the graduates for life-long learning; not merely for meeting college entrance requirements. These requirements need the support of all concerned.

Students and Gatherning Intelligence

Students need to appreciate the difference between

information and intelligence, and the use of the latter in government and corporations. The unsavory associations of the word **intelligence** has prevented an understanding of what is involved in gathering ethical and legal competitive-intelligence (Baatz 1994). A professional **Society of Competitive Intelligence Professionals** with 2,300 members is located in Alexandria, VA.

Student Recognition of Intellectual Capital

American business pioneers are finding that the chief ingredient of the emerging economy of knowledge is intellectual capital. According to **Thomas Stewart**, through the efforts of **Leif Edvinsson**, the director of intellectual capital at a division of the **Skandia Group**, the large Scandinavia financial service company, a method for measuring intellectual capital has been developed. As a result, the company publishes an annual report of its knowledge assets. It has been estimated by **Charles Handy**, a fellow at the London Business School, that "the intellectual assets of a corporation are usually worth three or four times tangible book value," (Stewart 1994c).

Students and Campus Applications

The first campus application students should become acquainted with is the automated library system. Presently, campus libraries should at least be where Wichita State University Library System has been for some time, described in a previous reference. Because of student interest, computer applications for study in greater depth as computer-supported systems are the **campus-wide information system (CWIS)** and **student information system (SIS)**. In combination, these applications attract student interest because the students are personally involved. Students, like all individuals, are more interested in learning about computer applications that involve them personally than systems used by some corporation or government agency. This instruction will also make faculty members learn how these systems work.

The other areas to be considered for student study are **human resources, alumni development, financial records system,** and **budget management**. Selection of applications for student study will vary from one campus to another depending upon the cooperation of the functional area managers. An example of this lack of cooperation is when **registrars** claim that they do not have sufficient time to explain to teaching faculty how their student registration system works.

The campus computer applications available for student study are similar to the systems they will encounter after graduation. Although there are many different systems supporting these functional areas, the basic principles are similar. Of greater importance is that students and faculties will be able to recommend improvements in the campus applications. Students will not only point out how computer applications can be improved, but can contribute toward making the necessary changes.

The design and development of computer supported systems including **reengineering, outsourcing,** and **imaging** systems are only a few of the many ways the education industry can improve IT

support. As it appears now, the individuals with the problems are struggling to help each other while most top administrators, the individuals really responsible, are preoccupied with fund raising and competing with each other for students.

Students and Application Development

End-users and their managers need to join the trend of becoming directly involved in project teams organized to design, develop, implement, operate, and update computer-supported systems and applications. Functional area managers are expected to assume joint or co-leadership of project management teams with the IT professionals. The knowledge development courses should include a concept of **iterative systems design**, including the concept of **CASE tools**, but not their detailed usage. Students and faculty need to be aware of the advantages and disadvantages of CASE tools.

Within the **Association for Computing Machinery (ACM)** the involvement of users playing an active part in systems design is referred to as **participatory design**. A special issue of ACM Communications recognized that participatory design is called a movement, one that began in Europe and has slowly spread throughout the international design community gaining strength and acceptance along the way (Crawford 1993).

Although not referenced in the discussion of groupware for electronic meetings, the EMS software is being used in the application of **Joint Application Development (JAD)** and **Rapid Application Development (RAD)**. This was brought out at the **Thirteenth International Conference on Information Systems (ICIS)** in Dallas (Carmel, George, and Nunamaker 1992).

Student Lessons From Historical Developments

History has a way of repeating itself. Only through an understanding of the advantages and disadvantages gained from the way information has been managed in the past will students benefit in the future. There are numerous examples from which lessons can be learned. One of these previously cited is the lack of exception reporting being used in many computer applications. Another is the failure to use simulation and other decision support systems integrated in the functional area application systems. The emphasis on stove pipe systems and lack of concern for the integration of these applications has prevented top management from having the information available for use in their decision-making process in executive information systems.

Students and Executive Information Systems (EIS)

The education industry has not made much progress in the use of **executive information systems (EIS)**. However, the concept has been used in the private sector for over a decade. By including EIS instruction in the knowledge development courses, students and faculty will help educate administrators as well as themselves in understanding and implementing the concept. Unfortunately, the present view of a collegiate EIS seems to be an automated fact book or briefing book. The EIS developments are more attainable than ever due to software called **middleware** that can access data stored in 50 or more different data structures.

The former barriers caused by differences in hardware, software, and networks are being eliminated. A leading vendor in providing academic assistance for the study of executive information systems is **COMSHARE Incorporated**. The company maintains an office for their **University Support Program** in Austin, TX. Another vendor that is building on the many uses of its software as a base for EIS development is **SAS Institute, Inc.** in Cary, NC. SAS, as an organization, has an academic based background.

Rather than continue to have computer-supported systems based on historical (not current) operational data, these applications need to include projections for planning and optimization. The use of **decision support systems** (DSS) and **simulation** tools are required. By being introduced to these tools through actual campus applications, students will become familiar with the advantages offered.

The most advanced EIS observed by the author at the college level is the program under development at the University of Missouri at Columbia. The MU effort most recently has involved moving the EIS database developed for a mainframe to an IBM RISC 6000. This successful prototype is now awaiting the University System's decision to use the EIS as an operational system on a day-to-day basis, or as many other schools do, use the EIS as an automated briefing book (Williams 1994). This and other experiences will provide much needed resources for course development.

The **ideal EIS** becomes an operational system making use of the information technology tools of decision support systems, expert systems, operations research, simulation, and similar techniques in an on-going manner. The institutional research professionals who use these IT tools should participate in classroom instruction. The best way to learn about tools is through their application. Greater use should be made of vendor software tools made available for academic use. In particular,these uses should include the development of campus computer applications.

Students and Communication Instruction

The inclusion of **instruction in communications** in the knowledge development courses will provide additional resources among the student body and faculty. Previous reference was made to the education industry's failure to provide sufficient instruction in both communications and information management. It was also pointed out that database management is now blending with communications as **Hackathorn** calls it **Enterprise Database Connectivity** with the additional use of the **warehouse** concept (Hackathorn 1993). Colleges and universities will benefit from having exposure to these and similar concepts included in the academic areas.

This need for instruction in communications is being recognized in one area as an example. This area is the **Conceptual Design/Information Arts** area of the **Art Department** at **San Francisco State University**. The **Arts & Telecommunications** course is an intermediate course to introduce artists to the

implications and functioning of contemporary telecommunications systems. The course is based on the recognition that telecommunications technology offers great opportunities and challenges (Wilson, S. 1993).

Students and Computer Programming

A course in computer programming can be compared with mathematics instruction in providing improved thinking skills for students. Unfortunately, through the years there have been and continue to be many courses for computer programming that attempt to teach programming to individuals who will never become programmers, nor should they attempt to program. Programming is a profession. It should be recognized as a profession. Justin Kitch's new programming language **FUNdaMENTAL**, referenced in Chapter 4, may make a difference. The language is usable by elementary school students beginning in the third grade.

Students and Fuzzy Logic

By including discussions of **fuzzy logic** in the knowledge development courses, students will gain an appreciation of the need for its application. Fuzzy logic aims at modeling the imprecise modes of reasoning needed in environments of uncertainty (Zadeh 1988). The inclusion of fuzzy logic will help offset the lack of appreciation of the subject in U.S. schools. Similar to the work of J.M. Juran and the late W. Edwards Deming in quality control, and Milt Bryce's information systems engineering, fuzzy logic is an important economic factor in Japan. A December 1993 Wall Street Journal carried a full-page advertisement of a fuzzy logic shaver, made in Japan. The fuzzy shaver continually senses the characteristics of the beard and automatically adjusts the speed to the beard's length and thickness (WSJ 1993).

Students and Virtual Reality

The U.S. military makes significant use of **virtual reality** and **simulation** in battlefield training. The knowledge industry needs to profit from these experiences plus the developments that have taken place with **hypertext, multimedia,** and **groupware.** In combination, the use of these and other developing interfaces provide for interaction with virtual reality called **cyberspace.** Greenberg and Witten defined cyberspace as an innovative and futuristic approach to human-computer interaction by immersing a person's senses in a three-dimensional simulated virtual world (Greenberg and Witten 1993).

Students and Creativity

One common topic is **creativity** since it has been recognized as a subject that can be taught. A recent study of creativity in information systems organizations concluded with recommendations for implementing a creativity improvement program (Couger, Higgins, and McIntyre 1993).

Students and Foresight

Corporations are learning that they can not rely on their customers to tell them what they want in the way of products. In spite of what is taught in marketing, in the development of the minivan there was never a letter from a housewife asking that one

be invented. To the skeptics, that proved there was not a market out there. This example is used by **Hamel and Prahalad** to show how their concept is for corporations to lead the public with new products rather than ask them what kind of products they want (Hamel and Prahalad 1994). This lesson applies to the knowledge development concept and courses recommended in this discussion.

Students and the Learning Organization

To many, including the developer of the concept, **Peter Senge**, the **learning organization** is recognized as one of the many fads of management ideas that come and go. As an author, I too must recognize that the knowledge development concept is also another fad. Although we both respect **Jay Forrester** of MIT as a mentor; it is my belief that much can be learned from the earlier concept of the learning organization and the knowledge used to form a foundation for further research and study. This is also an objective for my knowledge development concept. **Brian Dumaine** did much to capture for the Fortune magazine reading audience the concept of the learning organization as developed by Peter Senge (Dumaine 1994). However, for a more detailed account by Senge himself you are referred to his book The Fifth Discipline, first published in 1990, but in 1994, republished in a paperback edition (Senge 1994). The Senge concept appears to be reinforced by **EDUCOM's National Learning Infrastructure** referenced in the previous chapter (Graves 1994; Twigg 1994).

Other Areas of Interest to Students

There should not be any objection to the inclusion of **audit, ethics, privacy,** and **security** in the knowledge development courses. Entire campuses should benefit from more discussion and understanding of these subjects.

Colleges and universities, like organizations in the private sector, need all the help they can obtain in the **maintenance and upgrading of their campus computer applications**. This problem has increased due to the unfulfilled promises of client/server computing. By having the knowledge development courses fashioned and introduced by interdisciplinary instructors, resources available in computer science, engineering, library science, and business administration will become available. The integrated instruction used at Drexel University can become a valuable resource (Collison 1993).

GENERAL RECOMMENDATIONS

Recognition of Home-Grown Computer Applications

Many dedicated professionals in academic institutions and cooperative organizations have developed outstanding administrative computer applications for the support of common functional areas such as budget, campus-wide information systems, student information systems, and similar systems. The knowledge development agency and new department should support recognition, evaluation, and distribution of these outstanding applications. Commercial vendors will probably voice opposition; however, the academic institutions should be protected in their efforts to help themselves and each other.

Outsourcing Within the Education Industry

There has been much discussion of the outsourcing of administrative educational functions. Very little of the discussion has dealt with the outsourcing within the education industry itself. The support of military functions across command and state lines are examples showing what can be accomplished within the education industry. This concept should be expanded to by the education industry to use outsourching for schools and school districts to help themselves and each other. This support will allow educational institutions to support each other by sharing functional area workloads, yet maintaining a suitable educational base for administrators, faculties, and students. Savings can accrue from schools supporting and serving each other.

Students as Resources

Previous reference in Chapter 5 was made to students being a most valuable resource for the education industry. Colleges and universities need to appreciate their students as valuable resources. With proper recognition and an opportunity to contribute toward the benefit of the school as a whole, much can be gained from student effort. This was referenced in the previous discussion of students learning about campus computer applications.

Competition Between Four-Year and Community Colleges

The competition for students between community colleges and four-year colleges and universities must be eliminated. Their relationship needs to be that of cooperation and coordination.

Critical Thinking Research

The current K-12 research in critical thinking skills should be encouraged. My research did not include the critical thinking area; however, this effort can support the knowledge development concept.

Community College Involvement

As a group, the community colleges appear to be doing the best work of all the colleges and universities in meeting specific needs. This is because they are responding to the requirements of their communities and students--their customers. Briefly, the community colleges are, in the majority of cases, no-nonsense educational institutions demanding high volume work out of their faculties. In spite of the accomplishments to date, all community colleges can profit from the knowledge development concept. A special knowledge development course (courses) is (are) recommended for their use. In spite of the Maricopa Community College receiving the CAUSE 1993 Award for Excellence in Campus Networking, there are many schools isolated from networks. However, it is assumed that schools without E-mail, voice mail, and Internet access are taking steps to upgrade.

Evaluation of Knowledge Development Concept

A final concern in the knowledge development course is for the students and their faculty leaders to make an evaluation of how well their campus is applying the knowledge development concept. How well are the students, staff, and faculty prepared

to identify the needs and carry out the intentions of NII? It is often said that if a task is impossible to measure, then it becomes questionable whether or not the task should be performed. These courses should require student and faculty evaluations.

The class, as a team, including the faculty member, will have an educational experience in working as an evaluation group, and an opportunity for constructive criticism. These evaluations and their recommendations can become a continuing effort from one class to another, building on past experiences toward future improvements.

Criticism of Knowledge Development Courses

An anticipated criticism of these courses is that in no way can all the material be included in one quarter or one semester. In my experience, when a door is opened to students, and with proper encouragement, they will go ahead on their own. When they have problems, their first recourse beyond the help screens in the software, is to inquire from fellow students, then the instructor. After their problems are solved, it is a case of **GETTING OUT OF THEIR WAY!**

For example, at the College of William & Mary during the late 1980s, my students were required to use voice and E-mail where responses are at the convenience of the users. The old excuse of not receiving the word is hard to justify. Students find this access most rewarding because it provides an added relationship with the instructor that normal time and circumstances do not always permit. (In the K-12 grades, parents find voice-mail most convenient.)

As an instructor, I needed a directory on the campus computer system for students to obtain copies of handouts, assignments, lecture notes, and special instructions. The course syllabus was the first item in the course file. The syllabus could have been handed out in class, but it was easier to show on a screen with the file reference. Students were responsible to obtain their own copies of the syllabus and other documents.

My students were required to obtain sufficient understanding of **word processing software** on their own. After my introductory explanation of where to find the information they needed, they used the software tutorial at one of the campus computer labs. Over one weekend they could learn to write letters home and do term papers in the correct college format. During the next weekend they were able to download a small document from either a course file on the mainframe or on a server, make the directed changes in the document using the word processing software, and either print out the document for me or make it available for my review on my own computer screen. There are courses where students take a quarter or semester of word processing with the instructor using, for example, WordPerfect's 1014 page manual as a textbook. Their objective is to teach everything the student will ever need to know about word processing instead of teaching them how to use the manual for reference when they need it. Remember the Bible story of teaching people how to fish?

I used a similar method of instruction for **spreadsheet software**. Downloading numeric data for use on a microcomputer with spreadsheet software is similar to the wordprocessor example. The raw numeric data were organized in a file separate from the labels that give meaning to the numbers. Both files were downloaded and the spreadsheet software was used to organize the data. This required the insertion of a column for holding the labels, and making the column wider to accommodate the length of the labels. After reorganizing the data, the newly arranged file was made available for my review.

I also used a **fourth generation (4GL) relational database** for the class that included all three class sections. Students entered their own personal data into the database, including their selection of team or workgroup members. The group organization was necessary for future teamwork during the course. The students learned to access the database and obtain team listings in alphabetical sequence with little effort. The class database proved to be a useful instructional tool.

Each student team was required to plan a **database** for use in an application for solving a sorority, fraternity, or dormitory problem. Some teams used problems from home. One student needed a record-keeping system for a registered beef herd down home in Southwestern Virginia. By having each team meet with me for an hour during the evening or on a weekend, they could organize their database, get the program to generate the computer code of three or four hundred lines in 10 or 15 seconds, enter test data, and before the session ended, the team had printouts of their data. Most of the students had taken a semester of PASCAL or some other programming language. To watch the students see the **programming code generated automatically**, and then to have it generate their reports, was worth the extra time I spent working with these undergraduate students.

Please remember, this was during the 1987-90 timeframe. Colleges and universities not reaching this level of information technology use in the classroom by 1990 were not providing their students with the then-current instruction. The same was true for schools where their libraries were not automated. At that time, a few schools were even more advanced using multimedia.

FUNDING, A SAVINGS

The first negative attack on any new idea is to point out that the effort will cost too much, and major items will need to be curtailed or eliminated. For example, time and again when a city or community feels a budget short-fall, the first things many administrators identify for cuts are the fire department and the police force. There are more funds being used to support education and training efforts than most taxpayers realize. For example, the Information Infrastructure Task Force Committee identified eleven agencies with direct interest in the NII. These can divert funds for this effort. There can be major savings from the merger of the two major departments, education and labor. Research funds need to be redirected and applied toward the implementation of the knowledge development concept. The numerous

foundations that provide so much in the way of education and training funds and encouragement can be prevailed upon to support this national effort. No doubt, some state funds can also be used to support the development of knowledge.

School Busing

As **Ted Sharp** outlines in Chapter 5, there is more money to be saved through the elimination of school busing except for those mandated. For example, a recent visit to my grandson's third grade let me observe a number of minority students in his class. It was pitiful to watch them hovering together in small groups of two or three, with not a single minority parent present to observe the special program. According to my understanding of the current policy, these particular students have been selected to be bused for their entire gradeschool attendance.

LESSONS FROM CORPORATE AMERICA

As Hamel and Prahalad reason, although corporate America profits from using the information technology tools such as market research, forecasting, simulation, operations research, artificial intelligence, and many others; these only make top management think that they are looking into the future. They state that this happens because none of these tools necessarily yield industry foresight, and do not make senior management reconceive the coorporation and the industries in which they compete (Hamel and Prahalad 1994). This reasoning supports the knowledge development concept with a new look at what students should be learning, not what corporate America wants taught.

Some corporations and other organizations are looking for employees who can provide the knowledge needed by the organization. For example, **Koch Industries** in Wichita, KS uses a market-based management system and wants to make the best use of employees' knowledge. **Guy Boulton**, of the Wichita Eagle reported that Koch Industries wants employees to understand how they help the company make money, and it wants employees to focus on tasks that make the most money. Boulton also found that Charles Koch, the CEO of Koch Industries, says that he likes to use the quotation 'True knowledge results in effective action' and goes on to say that when you look at knowledge and learning in that sense, it's not just getting an inspiration or having a new idea; it's how to apply that (Boulton 1994).

AFTERWORD

It may be that **Carnegie Mellon University** is today's leader in attempting to carry out, at least to some extent, a portion of the knowledge development concept in its **exploit of technology**. A committee effort, headed by President Robert Mchrabian, feels that colleges and universities can mo longer afford to follow commercial organizations in finding and using modern technology, but must become aggressive innovators (Jacobson 1994b). This effort is one that the consortium, referenced above, should evaluate.

The use of the Internet to bring pressure on Intel to willingly replace the flawed Pentium chips is an example of what is to come with future channeling of public opinion.

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